Welding Engineer

July, 1960
50 Cents

University Microfilms Inc
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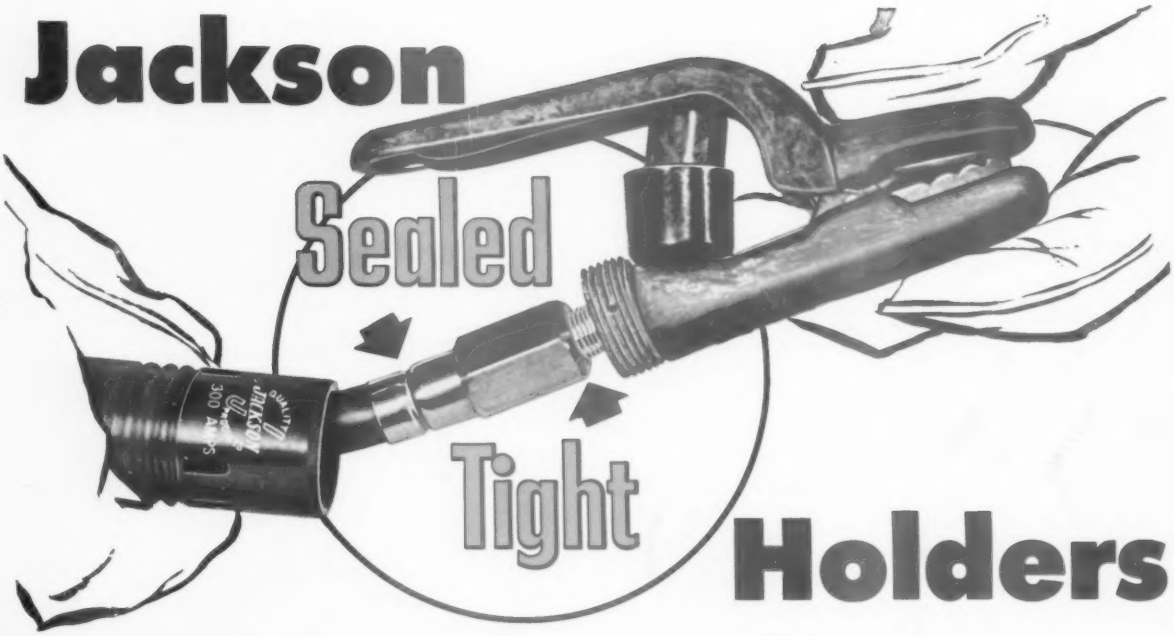
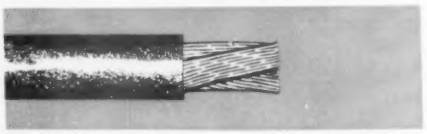
Jackson Sealed Tight Holders

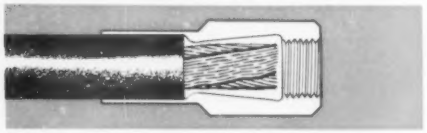


for trouble-free connections

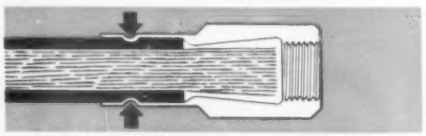
■ *Strip back the cable jacket–*



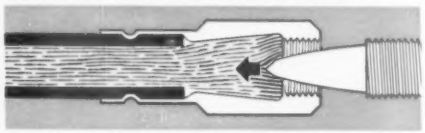
■ *Slide on the connection nut—*



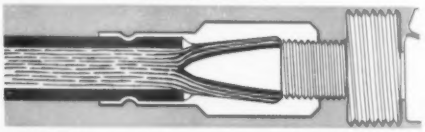
■ *Seal nut with crimping tool—*



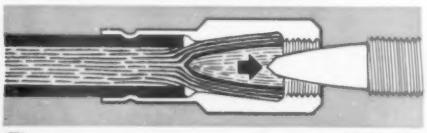
■ *Push holder stud into strands—*



■ *Wrench tightly into place—*



■ *Holder end may be replaced—*



■ *Connection assembly stays put!*

These copper alloy quality Jackson electrode holders have a permanent-type cable connection device good for the life of the cable. It grips the cable jacket as well as the cable, sealing out moisture and dirt. The jacket can't slip back, the strands won't flex and break. The 'stinger end' of the holder can be replaced repeatedly without remaking the connection.

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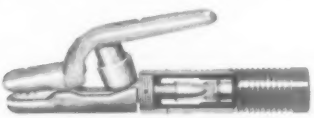
Get the utmost in conductivity, ease of connection, and long life. Get lower holder costs when buying ST holder stinger end replacements. Get a Jackson Sealed Tight holder in your hands soon and you'll *see* why they're better.



Model ST-3, copper alloy holder for electrodes through ¼" dia. Rated for 300 amps.

Model ST-5 copper alloy holder for electrodes through ⅜" dia. Rated for 500 amps.

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VOL. 45 — No. 7

Welding Engineer

The magazine of joining and severing of materials

This is welding: July, 1960

Cover photo . . . Weldor works on 24-in.-diameter gas pipeline. This section is part of 1,472 miles of main line connecting McAllen, Texas and Miami . . . Courtesy General Cable Corp.

W from . . . . . A

How to connect aluminum welding cable 25

Aluminum welding cable and present copper cable accessories can now be used simultaneously thanks to three recently developed connecting methods. **C. G. Sorflaten** and **R. A. Burkhardt** explain the fine points of these methods.

★ (For a reprint of this article, circle number 249.)

E

Quality control can be easy and accurate 28

Large structural weldments can be produced with a minimum of defects—if proper preparations are first made. Author **H. K. Eitelman** outlines one such quality control plan, which can be used as a guide by any and all manufacturers.

Steel, aware of competition, pleads its own case 32

The steel industry faces new competition in this nuclear age — but the competition, in turn, faces stiffer resistance as steel draws its battlelines and prepares an offensive.

L

Medium frequency induction heating offers advantages 34

Precise heat control, mobility, and (by using medium frequencies) higher power concentration characterize the induction heating method of stress relieving, as described by **Werner K. Haessler.**

★ (For a reprint of this article, circle number 250.)

D

Tig welding of reactor fuel elements improved 40

Author Stanley Donelson reports how a 99.75% efficient welding process had to be, and was, improved to comply with the strict specifications required for reactor fuel elements. With allowable tolerances measured in 100 thousands, this also explains why . . .

AEC experiments with ultrasonics to join fuel elements 41

I to . . . . . Z

irconium and stainless steel fuel plates may be fabricated with less difficulty in the near future. This will depend on whether current experiments will warrant construction of a conceptual ultrasonic welder for bond cladding full size aluminum, zirconium and stainless steel fuel element plates.

N

Also in this issue:

Big boom used to fabricate nuclear unit 31
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Published monthly, with an additional directory number in June, by Welding Engineer Publications, Inc. Second class postage paid at Chicago, Ill., and at additional mailing offices. Printed in U. S. A. Tear sheets of many Welding Engineer articles available free of charge up to 3 months following publication.

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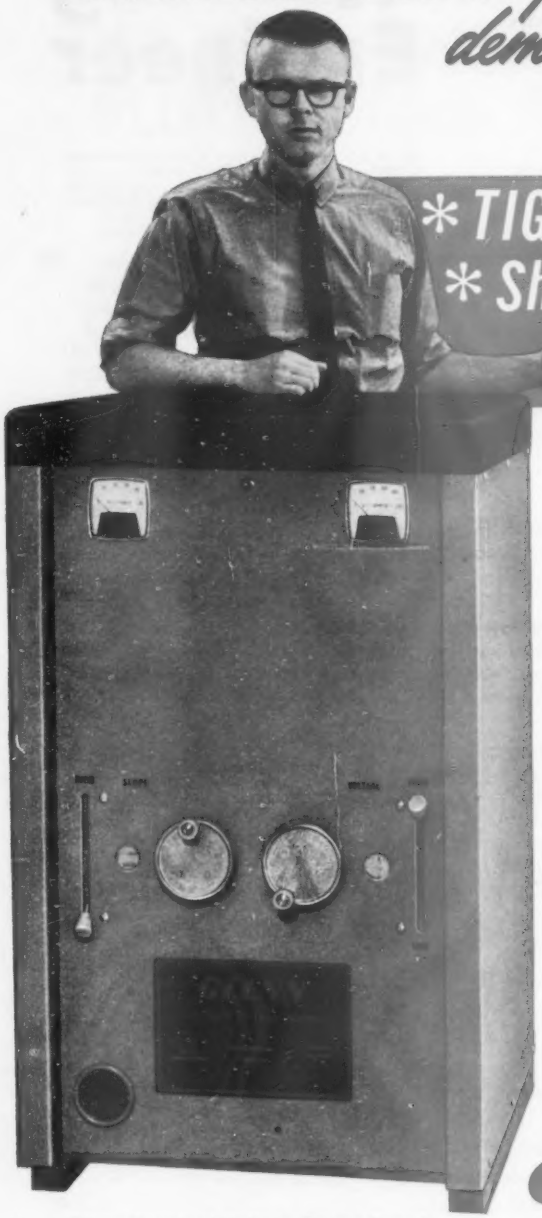
Modern welding processes like these demand a modern power supply!



* TIG (Tungsten Inert Gas) * MIG (Metallic Inert Gas)
* Short Arc * Submerged Arc
* Magnetic Flux

Glenn Constant Voltage Power Supply with Stepless Vernier Slope Control

Never underestimate the importance of the power supply to the proper operation of today's improved welding processes.

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Telephones:
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The Monautronic V-2 compensates for undesirable variations usually encountered in resistance welding by maintaining voltage across a weld at a constant value. This constraint of voltage amounts to constraint of final weld temperatures, and such temperature control assures production of quality welds.

- **Automatic lockout**—occurs when process variations are so severe that the available current range would not cover the requirements for quality welding. The control detects extreme contamination, failure in the force system, overwelding, poor matching or fitup, and any other conditions that would result in substandard welds.
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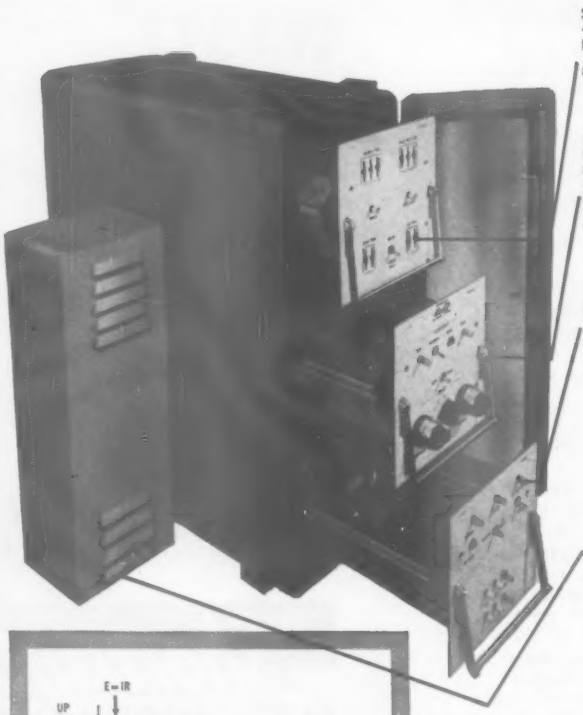
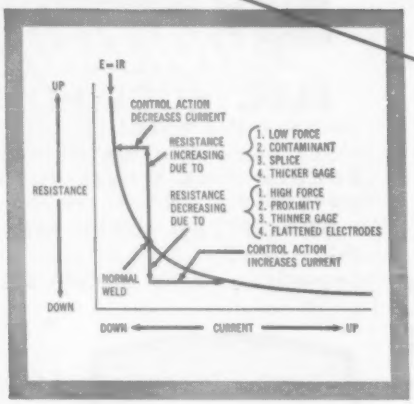
- **Modular construction**—permits easy removal of the three modules and separate firing unit, simplifies maintenance.
- **Shock and vibration resistant construction**—for long, reliable service in even the most demanding applications.
- **Safety interlock**—for protection of personnel during tip dressing.
- **Tamperproof case**—prevents access to control by unauthorized personnel.


SEQUENCE MODULE—Utilizes digital pulse-type circuitry . . . provides 100% accuracy.
HEAT CONTROL MODULE—Contains automatic and manual heat controls plus lockout devices. Processes input information from weld.
POWER SUPPLY MODULE—Power supply plus required auxiliary safety features.
FIRING MODULE—Provides large currents needed to fire ignitrons. Supplied as separate module.



VOLTAGE CONSTRAINT

Graph shows how voltage control compensates for process variations. Any point on curved line E = IR represents a specific voltage. With normal weld as reference point, certain process variations cause increased resistance, while others cause a decrease. Control action is achieved through change of current to constrain voltage to same level for every weld.

for complete details contact: THE BUDD COMPANY
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ELECTRONIC Budd CONTROLS

NEWS

PRESTON M. HALL, former president of the Resistance Welder Manufacturer's Assn., trains local resident in use of electric spotwelder at the U. S. Exhibit, 16th Casablanca International Trade Fair. Equipment and supplies came from 120 U. S. firms.

J. F. Lincoln to get Sullivant medal

The 1960 recipient of the Joseph Sullivant Medal will be James F. Lincoln, chairman of the board of Lincoln Electric Co., Cleveland.

One of Ohio State University's highest honors, the medal is given in recognition of an "admittedly notable achievement" in the arts and sciences by an alumnus, former student or faculty member.

Lincoln is credited with developing his firm's incentive management program.

Welding holds key to progress: Chyle

New metals can transform space age dreams into reality, if technicians can improve present methods of joining them.

This was the message of John J. Chyle, director of welding research for A. O. Smith Corp., Milwaukee, at the recent Design Engineering Conference of the American Society of Mechanical Engineers in New York City.

"As we make progress in the development of new materials and metals such as columbium, vanadium, zirconium, hafnium and tantalum," Chyle said, "the problems of fabricating these newer metals and alloys by welding must also be resolved, so that they can be used effectively."

Chyle described several new processes that may aid manufacturers, including two developed by the Russians—electroslag and friction welding.

Expect higher attendance at Western Welding Show

Considerably increased attendance is expected at the Third AWS Western Welding Show, to be held Oct. 13, 14, and 15 at San Jose, Calif.

In conjunction with the show, a welding conference is to take place, featuring discussions on such topics as welding of stainless steels, dip brazing of aluminum and magnesium, plasma arc, and joining for vacuum systems.

Two of the featured speakers will be R. P. Culbertson, Haynes Stellite Co., Kokomo, Ind., and G. E. Linnert, Armco Steel Corp., Baltimore.

B & D starts market research program

Black & Decker Mfg. Co., Towson, Md., has a launched an intensified program of marketing research in two of its electric tool product divisions.

Studies of the hardware and automotive lines have been undertaken, say firm representatives, to clarify and refine market classifications and definitions.

Chemetron to buy Scottish firm

Chemetron Corp., Chicago, has made arrangements to acquire Clyde Tube Forgings, Ltd., Glasgow, a leading British manufacturer of welding fittings for industrial piping and pipeline transportation systems.

Tube Turns Division of Chemetron will coordinate Clyde Tube's operations with its own. W. G. Conner, Jr., head of Tube Turns' international sales, will serve initially as managing director of the acquired firm's plant and sales organization.

Southwest metal show features newer processes

Interest ran high in the newer metalworking developments at the 2nd Southwestern Metal Congress and Exposition held at Dallas, May 9-13, according to the American Society for Metals, sponsors of the event.

Ultrasonic devices and systems for cleaning and inspection attracted the greatest attention from the thousands of technical representatives who attended. Technical sessions drew heavy audiences, particularly two talks on high temperature application and testing.

NEW Chicago district sales offices and warehouse facilities of Page Steel & Wire Div., American Chain & Cable Co., Inc., are located at 2040 N. Hawthorne Ave., Melrose Park, Ill. The warehouse area covers 48,000 sq ft, the office area 7,600 sq ft. Expansion forced the move from the former downtown Chicago location.

COMING EVENTS

JULY 14: Seminar on composite design, Illinois Institute of Technology, Chicago.

AUG. 22-26: Symposium on thermonuclear plasma physics, Gatlinburg, Tenn.

SEPT. 26-29: Fall Meeting, American Welding Society, Penn-Sheraton Hotel, Pittsburgh.

OCT. 13-15: AWS Western Welding Show, Exposition Hall, Santa Clara County Fair Grounds, San Jose, Calif.

OCT. 17-21: 48th Annual Safety Congress, Chicago; 1960 Philadelphia Metal Show, Trade and Convention Center, Philadelphia.

DEC. 5-8: 1st Biennial Short Course on Welding Engineering, University of Illinois, Urbana, Ill.

IIT sponsors design seminar

Illinois Institute of Technology is sponsoring a seminar on "Composite design in steel and concrete for bridges and buildings" to take place July 14 at 7 p.m. in Siegel Hall, Dearborn at 33rd St., Chicago.

Dr. Ivan M. Viest, bridge research engineer and principal speaker, will discuss "Research and design specifications for current composite design practices."

Ted B. Jefferson, publisher of WELDING ENGINEER, will lead the seminar.

Aluminum Assn. names to be used by ASTM

Specifications for wrought aluminum published by the American Society of Testing Metals will now identify these alloys by the Aluminum Assn. designations.

This will give the chemical industry an industry-wide specification under which aluminum and aluminum-alloy wrought welding fittings can be purchased.

Although the ASTM system for identification was established before the Aluminum Assn. system, the latter has been accepted as the industry standard. For several years the ASTM specifications have identified each alloy by both systems. The new procedure was approved by the ASTM committee on light metals and alloys, and will be recommended to the society for publication at its annual meeting this month.

Linde to open continuous rail plant

The second in a series of continuous welded rail plants operated by Linde Co., New York City, will soon go into operation at Birmingham, Ala.

Located on a site adjacent to the Ensley Steel Works of the U. S. Steel Corp.'s Tennessee Coal and Iron Division, the plant will be a complex of six buildings on a ten-acre site.

Rail will emerge from the plant in a dual stream, be loaded on rail trains, and immediately shipped to laying point.

Moon buys Yale Cincinnati branch

The Cincinnati Branch of Yale Materials Handling Div., Yale & Towne Mfg. Co., Philadelphia, has been purchased by the newly formed Moon Equipment Co., Cincinnati.

Moon will maintain headquarters at 9880 Springfield Pike as the franchised representative for Yale industrial truck lifts and tractor shovels in southwestern Ohio and northern Kentucky.

Greene Laboratories moves to new plant

Arnold Greene Testing Laboratories, Inc., formerly located in Cambridge, Mass., has moved to a new plant at East Natick Industrial Park, Natick, Mass.

The firm, engaged in commercial inspection, testing, and consulting, had a room specially designed to house its 1-million volt x-ray machine. Also included in the plant is one of the largest chemistry laboratories on the east coast.

Nuclear physics symposium scheduled for August

A symposium designed to provide an introduction to thermonuclear plasma physics will be held in Gatlinburg, Tenn., August 22-26.

The conference, sponsored by the Oak Ridge National Laboratory and the Oak Ridge Institute of Nuclear Studies in cooperation with the U. S. Atomic Energy Commission, is to be devoted to elementary aspects of achieving controllable release of energy in significant amounts from thermonuclear fusion reactions.

The symposium will consist of a course of four lectures on basic theory, with supplementary lectures on various separate experimental approaches and aspects of plasma physics of more general interest.

BEING lowered in place, at left, is first steel column in what will be the 20-story United Engineering Center in New York City. Being financed by voluntary contributions from industrial concerns and individual engineers, the center will house 18 major engineering societies representing 300,000 persons.

AT RIGHT, welders put in root passes for fabrication of box columns for the new building. The columns, made from 1¾- and 1½-in. plate, will run the full height of the structure to provide rigid load-bearing. Joints with a 45-deg bevel were completed in one pass with semiautomatic submerged-arc equipment of Lincoln Electric Co., Cleveland.

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2 New light weight, tempered aircraft aluminum shaft. Unbendable — unbreakable. Can't turn or come loose.

3 New Atlas "wide-blade" design. Wider chipping edge further increases chipping speed — adds to life of tool.

4 Formed hardwood grip that fits the hand. Locked on shaft so it can't turn or loosen.

Tough as they come!

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Letters . . .

Welding symbol?

Sir: *Troy, Ohio*

I'm intrigued by the steel industry's national symbol: Why not for welding, so closely allied and equally as important?

Seems to me that welding will always be associated with a bead, a seam, a joint—whether automatic, semi-automatic, stick electrodes, or gas welding.

So a symbol that wouldn't become outdated with future new processes and methods should perhaps be considered. Crazy?

Cliff Priest
Hobart Bros Co.

Sales engineer's role

Sir: *Annapolis, Md.*

The discrepancy between the stand taken by Mr. Earlbeck in his letter (June, p. 16) goes deeper than being merely the difference of opinion between two engineers.

The approach to a "customer" problem by a sales engineer is radically different from that of the consultant. The sales engineer's business is to diagnose the trouble, and work out a suitable solution in the shortest time practicable. This, in effect, equals getting relief from a temporary ailment by the use of potent patent medicine.

The role of the consultant is comparable to that of the physician. He takes sufficient time to determine the pathological cause of the illness before he attempts to cure it. The consultant is not satisfied with merely making the client complete a bothersome job. He determines the basic shortcomings of the organization that led to the occurrence of the troublesome job and instructs the personnel in the fundamentals, knowledge of which will equip them to avoid such trouble in the future.

Thus, a major function of the consultant is education, in addition to attending to current production problems. Again, compared to the physician, the consultant practices preventive medicine in addition to

(*Cont'd. on p.* 14)

NEWEST OF THE GREAT NEW MILLER WELDER/POWER PLANTS

AD-225-L
GASOLINE ENGINE-DRIVEN AC/DC WELDER/POWER PLANT

This is as close to being "an all-around hand" as you're ever likely to find. For instance:

A-C or D-C WELDING. The AD-225-L produces 300 amperes at 30 volts a-c or 225 amperes at 30 volts d-c – both at 100% duty cycle. Ample open circuit voltage gives superior results with a-c, d-c or a-c/d-c electrodes.

METALLIC INERT GAS WELDING. Using the d-c side of the AD-225-L, and with new style hand guns feeding small diameter wire from spools, aluminum, mild or stainless steel may be welded by the MIG process. Power for the gun is provided by the 115 volt d-c outlet.

A-C POWER PLANT. As an a-c power plant, this model produces 7 KW of 115/230v single phase 60 cycle current. In areas without electric power, the AD-225-L has proved to be a reliable and economical source of current for lights, appliances and tools.

AUXILIARY D-C POWER. While welding, the AD-225-L delivers 1 KW of 115v d-c which is ample for operation of flood lights, power tools, etc. Other uses to which this versatile model has been put most successfully include thawing of frozen water pipes, warming of viscous fluid for pumping, battery charging and, with addition of model HF-200 high frequency unit, tungsten inert gas welding.

Complete information sent promptly.

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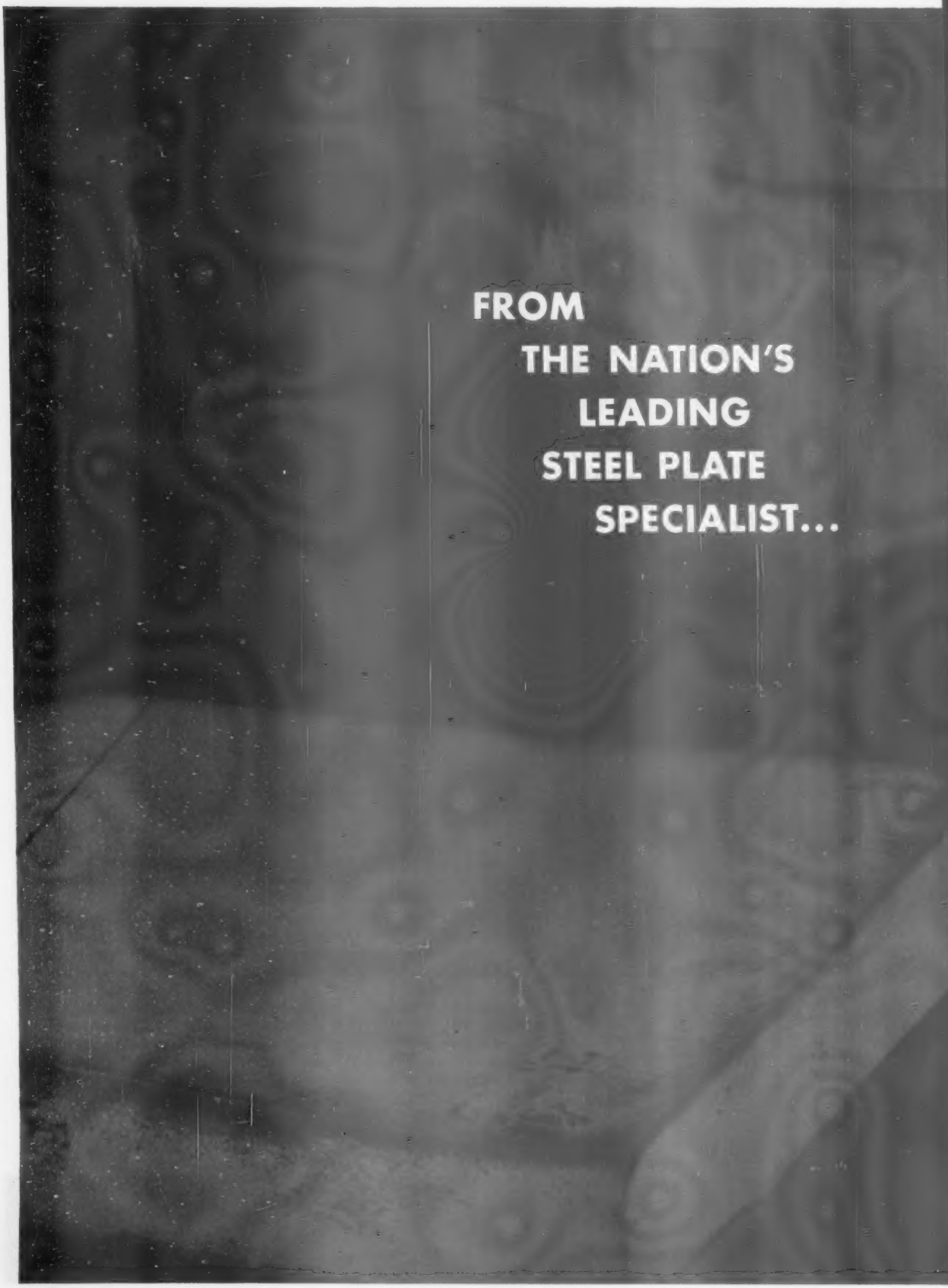
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LUKENS PLATE-MATE welding electrodes and wire

matched to Lukens Steel Company's broad line of carbon, alloy and clad steel plates and heads.

From a steel plate producer . . . a single source of materials supply for the steel plate fabricator.

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...Low Glare & Low Fuming Characteristics Assure Operator Comfort & Quality Results

GB 88 Flux is recommended for silver brazing steel, brass, copper, stainless steel, monel, inconel, chrome alloys, silver and gold. It is known throughout the industry as the "Production" flux . . . proved and dependable. Because operators recognize an improvement in the quality of their silver brazing jobs when they use GB 88. And they like its glare and low fuming characteristics.

GB 88 Flux is stable in use as well as in storage. It is fully active to 1650°F. Order GB 88 Flux in the size container that suits your needs.

For best results team up GB 88 Flux with GB Silver Brazing Alloys in the shape and size your jobs call for: random coils in all diameters, strips, straight lengths, pre-formed rings and special shapes.

Write for details. A FREE working sample of GB 88 Flux will be supplied promptly on request.

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DIVISION OF NATIONAL LEAD CO.
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curing acute and chronic ailments.

The householder has to use discretion and take the risk, whether a scratch suffered by a child should be treated at home, or should the patient be taken to a physician. Similarly, the fabricator uses his own judgement, whether a troublesome job represents organizational deficiency or is merely a phenomenon not yet experienced by his personnel, or may be brought under control by an alert and experienced sales engineer. In all cases, however, he assumes the responsibility which is involved in self-diagnosis.

The above discussion does not refute Mr. Earlbeck's claim as to the value of the free consulting service rendered by him and his associates. His case is exceptional, as proven by the remarkable growth of his organization. He earned his success the hard way, by giving prompt, competent service and through his seminars, offering opportunity to acquire basic information presented by competent instructors.

Bela Ronay

Film data

Sir: *New York City*

We noted in your June issue the Engineering Data Sheet No. 238, p. 47, a comparison chart of X-ray films.

We write you because the data presented in your chart seems to be at variance with similar data we have assembled. The attached chart shows the film alignments which we believe to be more accurate. I think ASTM put out a chart which is quite similar to the attached.

We hope these data are helpful to you and if we can be of further assistance, please let us know.

Donald D. Storing
Gevaert Co. of America, Inc.

(*We could not group the various types of industrial X-ray films into four classes. Taking the descriptions from the various manufacturers' catalogs, we found that we had to go into more detail—Ed.*)

Compliments

Sir: *Troy, Ohio*

Just a line to congratulate you on the handsome cover on the April issue of WE and overall improved format. You've got a good-looking, factual publication. Best wishes.

W. H. Hobart Jr.
Hobart Bros. Co.

cut man-hours to minutes

...with Black & Decker's Electric Hammer Line

2200 cutting blows a minute . . . that's how fast a Black & Decker Electric Hammer can break up masonry, scale weld splatter, channel in concrete or drill a hole. Man-hours drop . . . output soars! Every Black & Decker Hammer is *power-packed* to dish it out . . . *ruggedly-built* to take it . . . *user-designed* for easier operation. But see for yourself. Clip and mail this coupon NOW . . . or see your nearby B&D distributor. Four models, ¼" to 2" star drill capacity.

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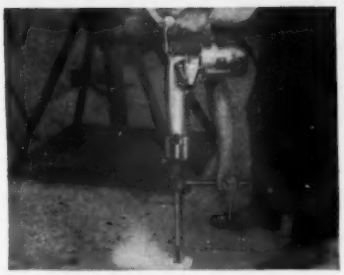

A HAMMER FOR EVERY JOB—a size for every need—that's the B&D Electric Hammer line! Four models give you a choice of ½", ¾", 1⅛" and 2" drilling capacity in concrete. And power-packed B&D Hammers' many *patented* features put them head and shoulders above the rest.

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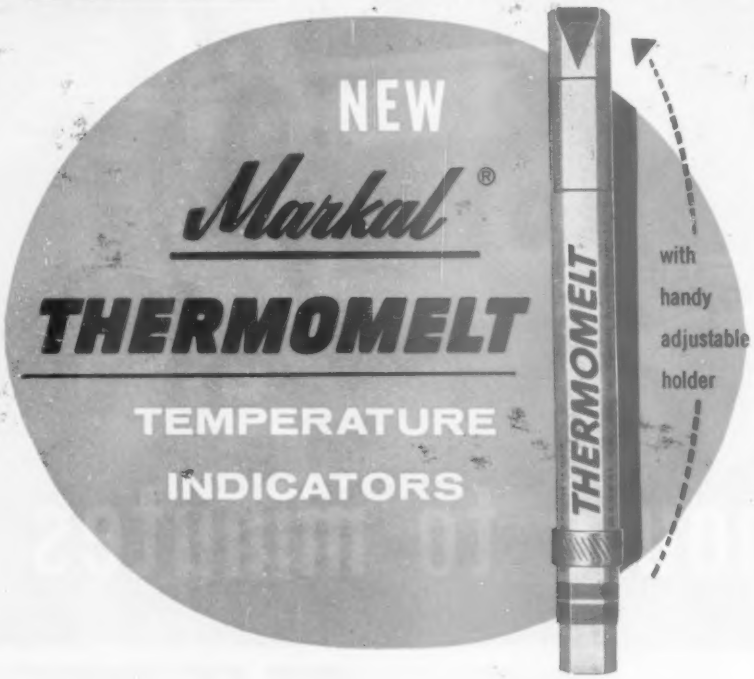
WHEN IT

MELTS

you know the *temperature!*



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exact working temperatures!

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Book Reviews

Flaw evaluation

WELD FLAW EVALUATION. Published by the Office of Technical Services, U. S. Department of Commerce, Washington, D. C., 1958. 117 pages, price $2.75.

This reprint of an original document resulting from government-sponsored research reports on a series of investigations made to determine a basis for the evaluation of the ability of weld flaws to initiate brittle fracture.

Four parts deal successively with (1) brittle fracture mechanics based on the Griffith theory and on Irwin's strain-energy release rate adaptations; (2) static tests on flawed butt welds; (3) static and dynamic tests on small butt weld flaws with and without residual stress; and (4) static tests on weld flaws in a controlled field of high residual stress.

Emphasis is placed on the importance that this residual stress has on the brittle fracture problem and the need for extended investigations in brittle fracture mechanics based on strain-energy release rates. Numerous tables, charts and photographs supplement the text.

Metallic coated products

ASTM STANDARDS ON METALLIC-COATED IRON AND STEEL PRODUCTS. Sponsored and published by the American Society for Testing Metals, Philadelphia, 1959. Price: $3.50.

This second edition of the standards is virtually a complete revision of the first edition issued in 1956. All but five of the 34 standards have been newly added, revised, or have had their status changed.

Among covered materials are zinc coated wire, strands, sheets, pipe and hardwire. Also included are aluminum coated wire and aluminum coated iron and steel articles as well as terne-alloy-coated sheets.

The 168-page manual contains 25 specifications, six methods of test, and three recommended practices. Numerous drawings, diagrams, and tables accompany the text.

WELDING ENGINEER

Your July, 1960 *Weld World*

As WE went to press, these were the industry's latest developments:

. . An amendment aimed at preventing the Air Force from purchasing and operating liquid-oxygen plants in competition with private industry has been proposed by Senators Ernest Gruening, E. L. Bartlett and John Marshall Butler. The amendment to the Defense Dept. appropriation bill for fiscal year ending June 30, 1961, proposes that no funds be used for production of liquid oxygen "unless the Secretary of Defense has certified that . . . commercial supplies . . . are not available at a reasonable price and a reasonable distance in satisfactory quality and quantity to meet requirements . . . "

. . Effective July 1, Bausch & Lomb Inc. is the new name of Bausch & Lomb Optical Co., Rochester, N. Y. The change was recently approved by stockholders in recognition of the fact that B&L is not restricting its research and manufacturing facilities to the field of optics alone. The firm was founded in 1853.

. . Survey among purchasing agents shows them about evenly divided on whether 1960 business has equaled or surpassed expectations . . . 47% say it has; 53% disagree.

. . Design Engineering Show in New York City set all-time record of attendance. About 22,500 visitors were registered at show which was held in the Coliseum. Previous record was 17,400.

. . Copper should be in abundant supply during last half of this year, if production continues uninterrupted. But if prices fall to a certain level, look for curtailment of shipments by copper producers.

. . Steel production moved up from the loss suffered by shutdown over Memorial Day holiday, but picture is still far from bright. Most mills report poor business, with inventories still being reduced by their customers.

. . Aeronca Mfg. Corp., Middletown, Ohio, has purchased The United Welding Co., also of Middletown. The former Baldwin-Lima-Hamilton division fabricates large weldments.

. . WELDING ENGINEER has established a scholarship for students in welding engineering at Ohio State University.

MISSILE AGE PAUL BUNYAN

LIFTS 80,000 POUNDS WITH THE STRENGTH OF

ATOM·ARC 'T'

Hufford Corporation specified all-welded construction for maximum strength, minimum weight

Transporting 80,000 pound rocket engine units and erecting them on test stands requires equipment that is unusual both in design and strength properties. Hufford Division of the Siegler Corporation met this challenging project for Thiokol Chemical Corporation with this mobile handling unit called the Transrector.

The first requirement as a transporter necessitated the use of a minimum weight material for fabrication to reduce the overall hauling load. The use as an erector made strength a highly important factor. This high strength to low weight ratio was achieved through the exclusive use of T1 steel. To retain the inherent strength of T1, the design engineers specified all-welded construction.

Alloy Rods Company's ATOM·ARC "T" more than satisfied Hufford's needs. The only electrode designed specifically to weld T1 steel in all applications, ATOM·ARC "T" weld metal physical properties equal or exceed those of T1 steel in the "as welded" or "stress relieved" condition for 100% design joint efficiency. ATOM·ARC "T" electrodes are also excellent for many other applications where high strength welds are required.

Detailed application information about ATOM·ARC "T" in data sheet form is available by writing Alloy Rods Company, P. O. Box 1828, York 2, Pennsylvania.

TWENTY YEARS OF LEADERSHIP IN THE DEVELOPMENT OF QUALITY ALLOY ARC WELDING ELECTRODES

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BETWEEN PASSES

on abrasives

We always like to remind people how important welding is to their everyday lives. In so doing, we sometimes neglect to mention the role played by abrasives. Wherever welding played a hand, more likely than not, abrasives also were used.

But there are areas we overlook when we think about abrasives, probably because our interest is focused on their applications in welding and other metal-working fields. In commemorating its 75th anniversary, Norton Co., Worcester, Mass., reminded us that we depend on abrasives from the cradle to the grave – quite literally. Your baby's teething ring is ground on an abrasive grinding wheel, and your gravestone is lettered by pressure blast nozzles charged with abrasive material.

Your dentist may have used one of the smallest grinding wheels, only 0.093 in., during your last visit to him. The nib of your fountain pen was delicately slit by a thin, small abrasive wheel. Your phonograph needle was ground by abrasive products. Even the shell of the egg you had for breakfast may have been cleaned with the coated abrasive known as sandpaper.

Abrasives are at work for home as well as industrial use. There probably isn't a thing manufactured today without the use, somewhere in the process, of grinding or cutting wheels or sandpaper.

WELDING ENGINEER is happy to salute the abrasives industry generally . . . and Norton Co. particularly, on occasion of its 75th anniversary.

suggestions pay

Additional earnings of $18,757 in the form of suggestion awards over the past three years have placed Robert Maciejczak, a scarfer for U. S. Steel, in a class by himself. His most recent award: $4,277 for a suggestion concerning a new type billet positioner for which a patent application is on file.

Employed in the alloy bar mill at South Works in Chicago, Maciejczak has submitted 37 suggestions since the program was started about three years ago. This latest award was not his largest – he once earned $9,033, the highest every granted at South Works. Although larger single awards have been paid, Maciejczak's total is the tops among U. S. Steel employees.

taxation

Any regular reader of the editorial page of WELDING ENGINEER is well aware of our stand on big government and confiscatory taxation. Ours is not an exclusive attitude, but we sincerely wish our representatives in Washington paid more heed to the conservative elements in this nation. The big spenders always want to spend *your* money.

All this is a prelude to a report on an editorial by Niels C. Miller in a recent issue of his *Memco News*. The president of Miller Electric Mfg. Co., Inc., Appleton, Wis., asks many of the same questions posed by this and other publications about harsh taxes.

But primarily the problem is not his nor ours alone . . . it is a national problem that needs a solution soon, else this country will lose much of the drive that has propelled it to its present position of eminence.

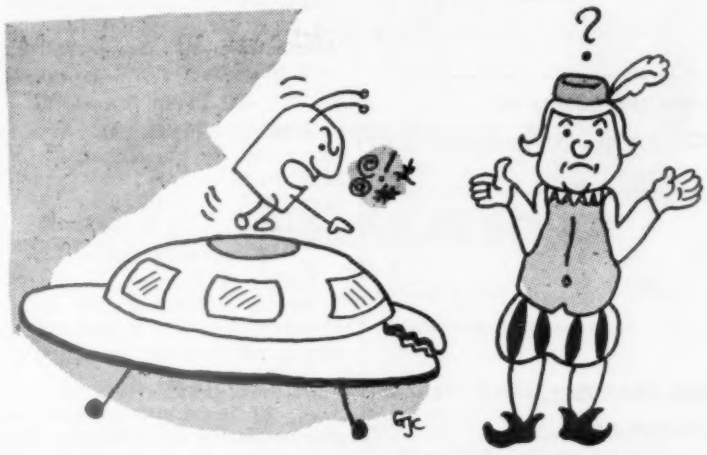
As Miller says, "It is hard to believe that in the United States of America, confiscation of property by taxation was ever intended by those . . . who originated our tax laws. I honestly believe the present senators and representatives can and would be willing to clear up the situation of double taxation on closed corporations. However, it must be brought to their attention."

And that is another problem – getting enough persons to raise their voices in protest over many of the confiscatory taxes which today are *legal*. Why should success be punished in the form of double taxation on corporate earnings and by excessive income and inheritance taxes . . . and for this robbery to have legal sanction?

ftt

the Bard

Shop condition: Screwier repair jobs every day.



. . . all is mended

A Midsummer's Night Dream, Act V, Sc 2

Ranite Hardsurfacing Rods

give **BEST RESULTS ON EVERY JOB**

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INCREASE PROFITS WITH ECONOMICAL MAINTENANCE

Ranite Rods:

- GIVE DEPENDABLE WEAR.
- FAST DEPOSITION GETS THE JOB DONE QUICKLY.
- EASY TO RUN—A-C or D-C
- NO SLAG TO FIGHT.
- EXCLUSIVE METALLIC COATING PROVIDES MORE DEPOSITED WELD PER POUND.

Ranite
WELDORS' NO. 1 CHOICE FOR HARDSURFACING

FOR COMPLETE INFORMATION SEND THIS COUPON TO:

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☐ PLEASE ADVISE WHERE **RANITE** CAN BE PURCHASED.

☐ WE WOULD LIKE TO DISCUSS OUR HARDSURFACING APPLICATIONS WITH YOUR FACTORY WELDING ENGINEER ON HIS NEXT REGULAR TRIP IN OUR AREA.

30 YEARS AGO

(Taken from **Welding Engineer** of July, 1930)

Gas welding of heavy plate is the subject of an article in this issue. The author is H. E. Rockefeller of The Linde Air Products Co., New York City.

—30 Years Ago—

The strength of welded boilers was demonstrated at Hedges-Walsh-Widener, Co., Chattanooga. A report was read by A. J. Moses, the firm's engineer, to the convention of the National Board of Boiler and Pressure Vessel Inspectors. Attempts to blow up the welded boiler made a strong impression on the inspectors who have always insisted on riveted construction.

—30 Years Ago—

The Sutton-Garten Co., Indianapolis, is celebrating its 15th anniversary this year.

—30 Years Ago—

One of the first successful "talkie" industrial motion pictures to be produced was recently released by the American Steel & Wire Co., a subsidiary of United States Steel Corp.

—30 Years Ago—

Additions to the plant and equipment of Tube-Turns, Inc., Louisville, will increase production 60%, according to W. H. Girdler, president of the Girdler Corp., which operates Tube Turns.

—30 Years Ago—

William Stringham has been made assistant vice president of American Rolling Mill Co., Middletown, Ohio. He started with the Armco firm as a roller.

—30 Years Ago—

A doctor of laws degree was conferred by the University of Wisconsin on L. R. Smith, president of A. O. Smith Corp., Milwaukee.

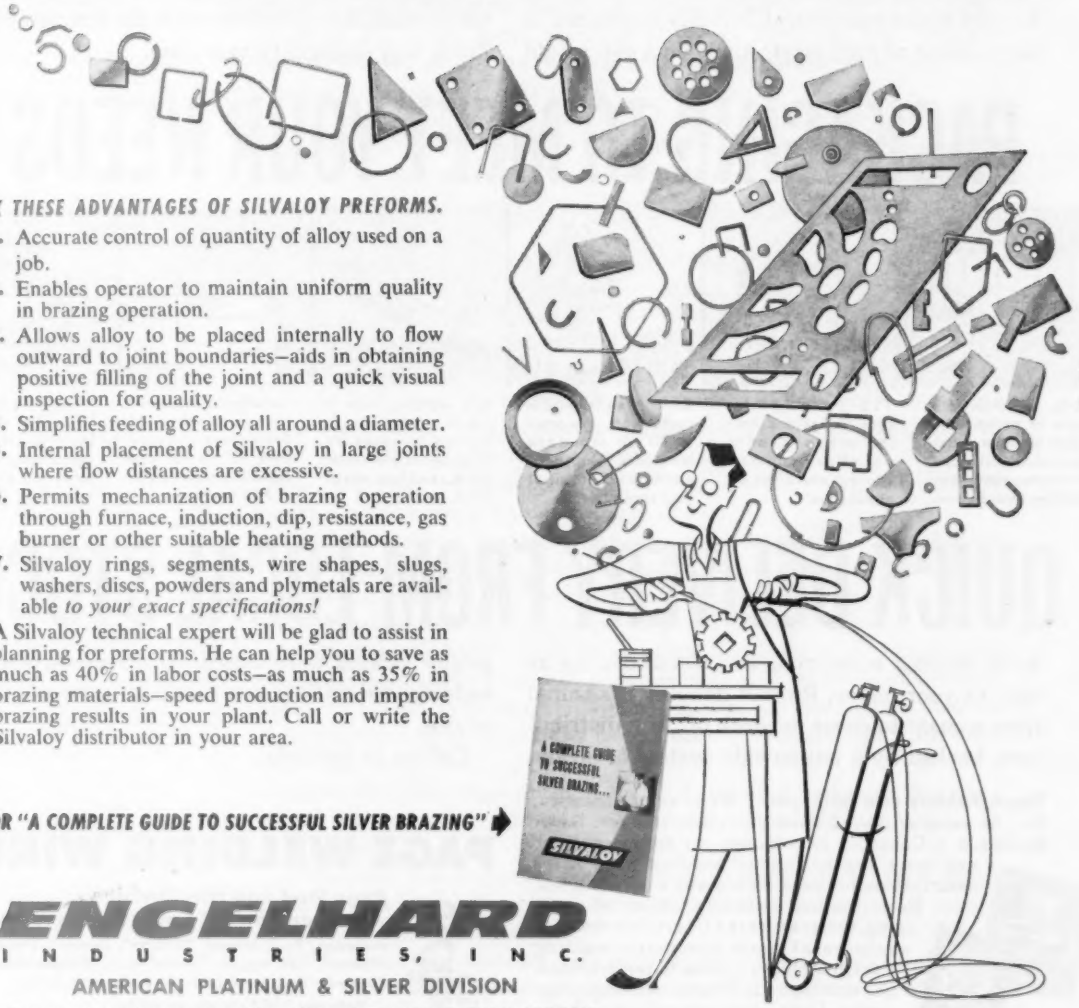
—30 Years Ago—

Parker B. Francis, secretary-treasurer of Kansas City (Mo.) Oxygen Gas Co., is making a two-month tour of the country.

—30 Years Ago—

An article on spot welding of structurals, by John Blanke, describes the use of the process in construction of lightweight steel frames for houses.

CUT TOTAL BRAZING COSTS *BY AS MUCH AS 75%* WITH SILVALOY PREFORMS



CHECK THESE ADVANTAGES OF SILVALOY PREFORMS.

1. Accurate control of quantity of alloy used on a job.
2. Enables operator to maintain uniform quality in brazing operation.
3. Allows alloy to be placed internally to flow outward to joint boundaries—aids in obtaining positive filling of the joint and a quick visual inspection for quality.
4. Simplifies feeding of alloy all around a diameter.
5. Internal placement of Silvaloy in large joints where flow distances are excessive.
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A Silvaloy technical expert will be glad to assist in planning for preforms. He can help you to save as much as 40% in labor costs—as much as 35% in brazing materials—speed production and improve brazing results in your plant. Call or write the Silvaloy distributor in your area.

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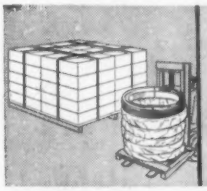
THE WIDEST CHOICE OF WELDING WIRES

FROM 33 ANALYSES of automatic welding wires, PAGE can supply the *right* wire for *any* welding operation. For instance, for welding high-carbon and sulfur-bearing steels, PAGE Analysis A-S-18 is the answer. It's the first successful wire developed for this purpose. Or for jobs where exceptional ductility is required in the welding of mild steel, Analysis A-S-6 would be the choice. When particularly tough welding problems exist, we can develop *special* wires to solve them.

PAGE also supplies a complete range of metal spray wire, bare and sulcoated electrodes, and gas welding rods. Regardless of *your* welding requirements, PAGE can furnish the *right* wire—with the size, temper, finish and uniformity you need.

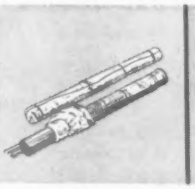
PACKAGING TO MEET YOUR NEEDS



25-lb. or 60-lb. coils, single or palletized—also in single or palletized individual cartons, or in waterproof reusable fiber-board drums.

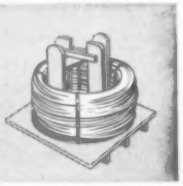
120-lb. or 180-lb. coils, paper-and-burlap wrapped, or in palletized cartons. Special coil sizes on application.

25-lb. reels (spools) in cartons are designed to fit all standard machines; single or palletized to meet your requirements.



Gas welding rods in 50-lb. paper-and-burlap bundles; in fiber-board cartons of 10 lb.; and in boxes of 50 lb. or over.

Payoffpaks and Leverpaks are furnished with diameters ranging from 15" to 23" and capacities from 250 lb. to 700 lb.



Payoffpallets hold 900-1200 lb. of wire (sizes 5/16" to 3/8" incl.) coiled around pedestal on top of a wooden pallet.

QUICK DELIVERY FROM LOCAL STOCK

PAGE welding wires, rods and electrodes are as near as your phone. Prompt delivery is assured from a coast-to-coast network of PAGE distributors, backed by a nationwide system of strategically located warehouses. At all times, PAGE welding specialists are ready to give expert advice.

Call on us for help.

These Folders can help you... *Write us at Monessen, Pa., for name of nearest* PAGE *distributor and for:* **Folder DH-402-0** • Contains information on submerged arc and inert gas automatic welding wire. Lists descriptions and uses of the many PAGE analyses. Describes our extensive variety of packaging. **Folder DH-1218** • Chart lists detailed analyses of PAGE automatic welding wires, metal spray wires, bare electrodes, gas welding rods. Shows uses and properties. Lists most competitive makes.

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ACCO

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American Chain & Cable Company, Inc.

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*Indicates PAGE warehouse stocks

PAGE —the source for answers to welding problems

JULY, 1960

Welding Engineer

ESTABLISHED 1916

Land of the free (handout)

AFTER READING WELDING ENGINEER'S May editorial, "The evil: complacency," R. L. Townsend, president of Tweco Products, Inc., Wichita, Kan., forwarded two letters received from a management consultant firm. Excerpts from the first letter follow:

" . . . contract with the International Cooperation Administration, U. S. State Department . . . involves assistance to small businesses engaged in welding. We are asked to furnish all available charts, manuals, books, technical publications and visual aids which may be of value to the welding industry in Japan.

"We would like to obtain samples, to be left in Japan and become permanent property of the Japanese Productivity Center. It is normally the practice to make such samples available without charge in return for the public relation value." (The second letter was a followup request.)

Not only have the U. S. taxpayers given other nations some $72 *billion since* 1945 *to acquire the finest tools in the world, but now we find our State Department hiring management consultants and industrial engineers to ferret out sample products for other countries.*

Why are these products being sought? To be copied and sent back for sale at a much lower price on the U. S. market?

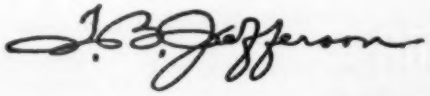
American industry is severely handicapped because of the imposed tax load to make possible an average annual $5 billion give-away. During this same period, inflation has increased tool replacement costs about 200%, while wage increases have far outpaced productivity increases.

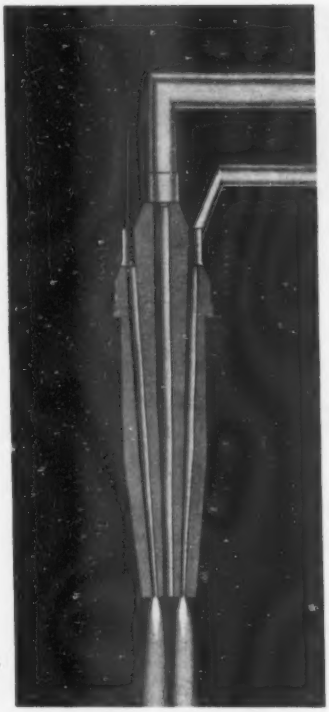
While these conditions would be sufficient handicaps to discourage most manufacturers, we find we still must compete with a considerable wage differential. Our average metal worker is paid six times more than his Japanese counterpart, four times more than the German, and three times more than the English.

Unless the State Department is out to deliberately make our country a second rate nation, why are they so interested in bolstering other economies at our expense?

If American manufacturers are continually confronted with these handicaps, we will soon lose most of our foreign market and, in some cases, a great deal of our home market.

Maybe your Congressman and Senator should know your feelings on this. At least his reaction would be interesting. Why not write him now?





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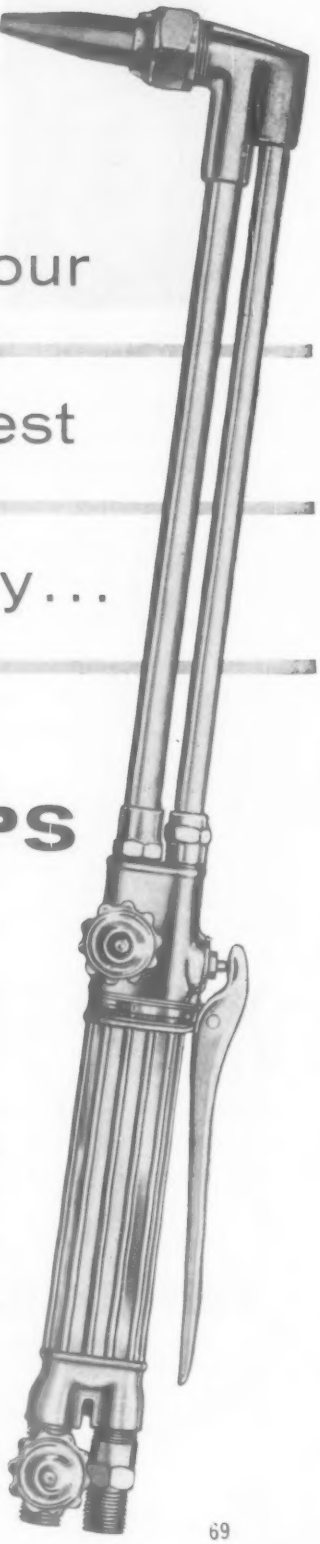

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69

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CROSS section views of three connecting methods: from top to bottom; mechanical ball point, indent compression and screw cone.

Until now copper and aluminum have been incompatible, but three connecting methods have provided an ideal wedding.

How to connect aluminum welding cable

by **C. G. Sorflaten**
and **R. A. Burkhardt**
Kaiser Aluminum & Chemical Sales, Inc.

ALUMINUM WELDING CABLE, although extremely lightweight, flexible and low in cost, could not be used successfully because of its incompatibility with present copper cable accessories.

As a result, three methods for connecting and terminating aluminum cable were developed, and then applied to electrode holders, terminals and splicers.

Complete assemblies of aluminum cable with accessories incorporating these new connecting methods are now under field evaluation and first results show not only excellent performance on aluminum cable, but far better performance on copper cable as well.

Use of aluminum stranded conductors in electrical applications traditionally has been one of substitution for copper. This has worked to aluminum welding cable's disadvantage because:

1. Attempts are often made to utilize aluminum welding cable in fittings, holders and other accessories designed for copper cable operation only and, thus,
2. Often producing early terminal failure and discouraging attempts to develop acceptable aluminum cable accessories.

In the past each successful conversion to aluminum conductor required a modification of accessories to be used with it. For example, conversion to aluminum transmission conductors required a completely new line of aluminum dead-end fittings, splicers, tap connectors, etc., before it could be marketed as a replacement for copper transmission conductors.

Present conversion to aluminum building wire is another example. Terminations on all electrical equipment for the building trade are now undergoing rapid transformation; high strength aluminum alloy terminals are replacing copper designs so both aluminum and copper conductors can be used on these devices.

These examples show the need in the welding industry for a revision of existing copper and brass holders, splicers, terminals and other electrical devices now used on copper welding cable and designed exclusively for copper conductors.

A recent survey indicates that only a few aluminum electrode holders and splicers are available. Although these performed acceptably on aluminum conductors, many users were reluctant to change because of preferences for present connection methods and accessory features they considered essential. It also meant complete accessory replacement in many cases.

Since many users had a preference for a particular connection method, conversion to aluminum cable had to utilize these same methods as nearly as possible.

Thus, using the three most popular methods (mechanical, compression and screw cone), design standards for connection of all aluminum welding cable sizes were established. (Soldering, although used successfully in a few isolated cases, required too much technique to be readily acceptable as a connecting method, would also be subject to corrosion because of flux.)

The most successful mechanical connection, developed by a welding accessory manufacturer, utilized a large diameter screw with a ballpoint. A high, localized pressure is created under the ball-point, thus creating considerable conductor deformation and establishing a low-resistance.

Either aluminum or steel set screws in an aluminum connector body are used. Tests indicate that good performance can be obtained for extended periods even without use of grease type compounds.

For complete reliability on all

sizes of aluminum cable, simple performance standards were established and were successfully applied in development of building wire equipment terminals. These standards, which have proved adequate for reliable service, consist of the following rules:

1—The operating temperature of the connection should not be greater than that of the conductor when measured at some distance from the connection.

2—The body of the fitting should be tin-plated aluminum to replace the ever-present oxide surface. Although both aluminum and steel ball-point screws can be used, the former gives slightly better performance. Screws should be cadium-plated to provide the best possible screw efficiency and screw threads should be lubricated with either a soluble wax or other suitable lubricant.

To determine the number of ball-point screws for a given cable size, tests were conducted to determine the relation between cable temperature and that of a number of ball-point splicer designs.

Splicers with one, two and three ball-points per screw conductor were tested and splicer temperatures were corrected to 90 C cable temperature for all sizes.

The results indicate that although splicers using one ball-point screw operated at temperatures higher than conductor temperature, they could be made to operate satisfactorily on welding cable sizes up through 1/0 AWG when designed with a smaller wire groove.

Splicers with two ball-point screws were found to operate satisfactorily on 2/0 and 3/0 AWG but would run considerably hotter than the cable when used on 4/0 AWG cable, this last being remedied by using three ball-point screws.

Heat cycling tests showed that when temperatures of aluminum bodied connectors do not exceed cable temperature, stability is usually achieved over an extended period of operation. Although this development work was conducted without using grease type compounds, these are recommended and should be used in the field to insure stability under severest conditions.

However, should the case arise where grease compounds are not available or have been omitted for some reason, satisfactory performance can be expected for a considerable length of time.

These standards can be applied to termination of either aluminum or copper welding cable to aluminum bodied splicers, electrode holders, other electrical devices.

Where these devices are copper alloy, the addition of an aluminum bodied mechanical connector can be made by a threaded connection as shown in figure 2. Note that this connection is best made with an interference thread fit on the mating parts. The copper alloy should have the male thread.

Aluminum compression connectors are available in two forms, tubular splices or compression lugs. Because building wire constructions are somewhat smaller in physical size than welding cable of the same AWG size, it is necessary to select one size larger lug or sleeve than the welding cable size.

Thus, a 3/0 AWG welding cable will require a 4/0 AWG lug or splicer and a 4/0 cable will require a 250 MCM lug or splicer.

Of the compression methods available, the indent type appears the most feasible. One hand tool can be utilized for the entire range of aluminum welding cable sizes and requires less total applied pressure than circumferential methods.

Indent compression produces a cable distortion similar to that produced by ball-point screws. A thin crescent-shaped conductor section is produced by both methods, giving considerable surface contact area for the enclosed conductor.

The thinner the crescent becomes, the more efficient the connection. Thus, with finely stranded welding cable, all inner strands are close to a conducting surface and are not required to conduct current successively from strand to strand through a great distance.

To utilize this method of connection, a means of attaching this soft aluminum compression sleeve to devices of either brass or aluminum was required. Testing proved the sleeve could be compressed onto a threaded stud with a circumferential compression, and would perform satisfactorily.

If the stud was aluminum, it was first tin-plated to replace the surface oxide; if brass or copper, no plating was done. Figure 3 shows diagramatically the application of the sleeve to a threaded stud.

Of the various cable sizes, 4/0 AWG appears most difficult to connect, and thus, the tool setting for this size is one size smaller than the cable, *i.e.*, a 3/0 AWG tool setting is used whereas the sleeve size is actually 250 MCM.

In addition, reliability can best be obtained if the sleeve is tin-plated. On sizes smaller than 4/0 AWG, an unplated sleeve one size larger than the cable is required, with the tool setting the same size as the conductor.

This aluminum sleeve can also be used for connecting copper welding cable. Note that grease type compounds are required with these compression connections and present practice is to factory-fill the compression fittings with these compounds.

Screw cone connections have also proved quite reliable when used with aluminum welding cable, and of the three methods, seems the easiest to adapt to present holders and accessories.

For increased efficiency, slight modifications were incorporated in the usual screw cone design. First, aluminum alloy 6061-T6 or 2011-T3 was used for cones and wedges.

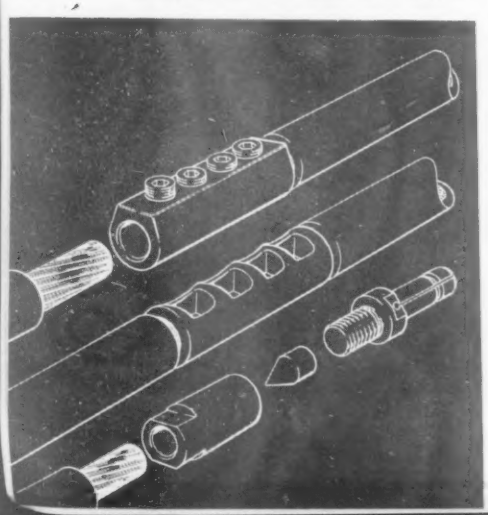


FIG.1—Three methods for connecting and terminating aluminum welding cable were developed and applied to electrode holders, terminals and splicers.

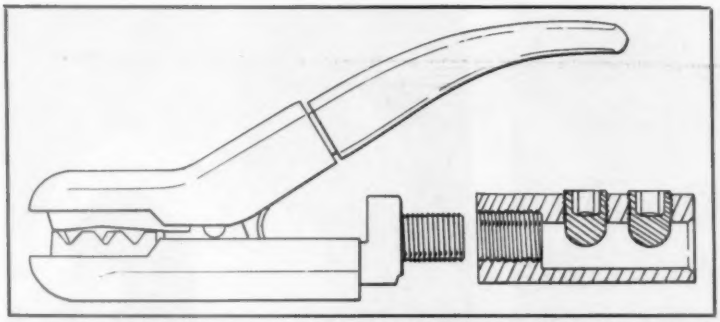


FIG. 2—Aluminum bodied connector, tin-plated with standard female thread can be used on electrode holder having a copper alloy stud with an interference thread.

These could be used on either aluminum studs or on brass studs on present holders and splicers with equally good results.

To produce slightly more cable deformation, the pointed wedge was removed as an integral part of the screw and used as a separate, independent component. The wedge can thus be forced into the conductor when the outer nut or cone is screwed onto the holder or splicer.

This eliminates turning of the wedge within the conductor strands as rotation is achieved, thus permitting wedge modifications.

A very high compression was obtained when the wedge had a pronounced shoulder. The cable was thus deformed into a thin ring having considerable inner and outer surface contact area.

The inner strands within this ring are a very short distance from either the outer or inner conducting surfaces. Cycling tests proved this method can easily be adopted for all aluminum or copper welding cable sizes through 4/0 AWG, and that stability can be obtained without use of grease compounds.

These compounds, however, are expected to be used in the field to produce complete reliability over extended periods of service and for cases of severe duty.

A range of cable sizes can also be incorporated by changing the wedge dimensions; thus one wedge can be used for 3/0 and 4/0 AWG cables and slightly larger wedges for 1/0 and 2/0 AWG cables.

For economy and better performance, aluminum alloys have been used to fabricate entire assemblies of present quick-disconnect splicers. These connector designs are somewhat easier to incorporate in an aluminum bodied fitting, and mating parts can be made identical to present brass quick-disconnect splicers.

All splicers have been made of aluminum 6061-T6 to the same mating male and female design as existing splicers. These are then tin-plated to remove the oxide surface and provide a low contact resistance.

Tin-plating of sufficient thickness can be specified for this service to withstand the number of operations usually encountered during the life of the accessory or the cable. By making the entire assembly of 6061-T6, the ball-point screw connection becomes an integral part of the connector.

The alloy also provides a high quality thread for the use of a screw cone connection where that method is used. The attachment of a compression sleeve can also be made to a similar threaded stud.

Tests have shown that these aluminum alloy quick-disconnect fittings operate cooler than the brass fittings which they replace. They also have a greater conductivity percentage than brass and the tin provides a very low contact resistance.

These fittings can also be used interchangeably with most present copper fittings, *i.e.*, a male aluminum fitting can be plugged into a brass female fitting and yet achieve reliable operation.

Samples of presently manufactured accessories were modified with each of the three connection methods to show their practicability and to initiate testing on aluminum welding cable. A field evaluation has been started, but it is too early for a complete evaluation since most installations have been quite recent.

However, to date only flex or fatigue failures have been reported, which indicates the necessity of keeping the cable connection well within the confines of the electrode holder. Where it extends too close to the holder's handle end, flex fatigue will occur.

Where it is desirable to maintain voltage drop and temperature rise to the same values specified for copper welding cable, an aluminum welding cable should be selected two AWG sizes larger.

The slightly larger cable will have approximately the same resistance, but due to its larger surface area, it will have a slightly greater current carrying capacity.

Note, however, that this difference in size still provides a favorable weight saving since the bare aluminum conductor weighs one-half its copper equivalent. When these conductors are jacketed, the aluminum cable is still approximately 30% lighter than copper.

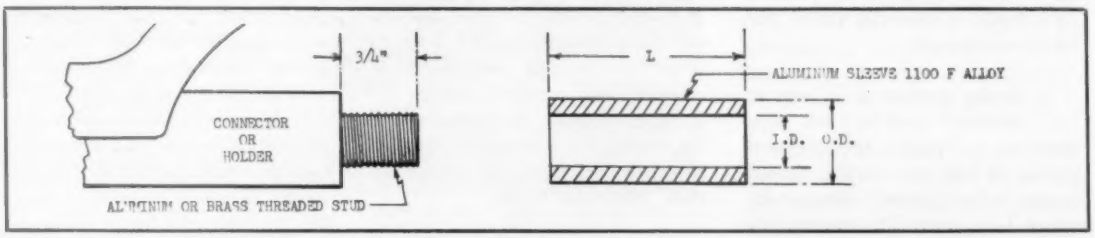


FIG. 3—Application of aluminum compression sleeve to a threaded stud

Quality control can be easy and accurate with careful preparation

STEEL drive base housing for a radar antenna is manual arc welded. Before any welding operation is begun, the weldors should be included in a design discussion.

by **H. K. Eitelman**
Quality control inspection planner
General Electric Co.
Pittsfield, Mass.

WELDING HAS ADVANCED to a level of near perfection.

This means today's weldor can produce the type of welds required for large structural weldments with a minimum of defects.

Procedure methods suggested below will probably become obsolete within a year. But they will introduce statistical methods to large weldment processes.

Result: areas where more advanced methods will prove beneficial can be pointed out. However, this information may be used only as a guide to minimize errors due to defective work.

A similar system is in use at GE's Pittsfield plant and has been effective in quality improvement during its first year. In the revised system below, several refinements, which have proved to increase effectiveness, are included. Many of the obvious operations, however, have been omitted.

It is important to know that the weldment is being processed correctly from design to final machining. To best meet this condition, a team with various abilities is a prime requirement.

Each member must realize he is an important link in the chain, and that the success of his project depends on the co-ordination of his knowledge and efforts with those of the other members.

A minimum of one each of the following should be included on the team: design engineer; weldor; inspector; process and methods planner; and quality control inspection planner. Best results will be obtained, of course, by assigning men with wide experience in their particular fields.

The design engineer knows that because of material characteristics inherent in metals, every weldment design will present different problems. And since it is almost impossible to know where all problem areas will exist, he must create his design carefully, trying to incorporate proven weldment methods wherever possible.

In order to realize a greater savings, he must be sure that: proper material is used; sufficient material for machining is included; structural design is correct; weld requirements are not excessive; and weld joints are located to give the weldor the best conditions.

When the weldment design is complete, it should be studied by all team members, and their planned production methods discussed jointly. It would be wise to record this discussion for future reference.

When agreement is reached,

piece parts can be prepared, but only one set of parts even though the contract order calls for more than one weldment. In this way, the first weldment is a development model which can point out necessary revisions due to shrinkage and unpredictable factors.

Selection of weldors should be made with care. Most weldors are usually outstanding in one particular welding process or welding on one particular material. The welding foreman usually knows which of his men is most capable.

If the work load warrants more than one weldor, best results are often obtained by specializing each weldor, especially when more than one of the product is to be made and a team of weldors can be used. Specialization of each weldor takes advantage of a natural tendency of all workers to improve quality with repeated similar operations.

Prior to commencing any welding operation, a design discussion with the weldors can prove beneficial, *e.g.*, on machining requirements they may suggest certain "tricks" they have found effective. The discussion can also be used by the methods planner to improve his operational plans.

The welding inspector must be thoroughly familiar with the weldment design since any errors made in inspection can be costly. Additional care must be exercised with the first fabricated weldment because it will point out necessary part dimensional changes and process changes.

ALUMINUM drive supports for a radar antenna are Tig welded. Prior to welding components, a operation sequence minimizing configuration changes and shrinkage should be set up by the methods planner.

To minimize inspection time between operations, the inspector should study the drawings, inspection instructions and check-off sheets prior to inspection.

Close coordination between the inspector and the quality control inspection planner is necessary. By properly combining their efforts and knowledge, they can assure the manufacturer that quality control is in effect at all times, and that defects are being minimized.

Before welding the components, the methods planner should list and record a sequence of operation which he feels will present a minimum of configuration changes and shrinkage during welding. By studying the design, he can determine where special welding equipment and fixtures are to be used.

To assure consistent results, the weldor's methods should not deviate from these instructions. If changes are made, they should be recorded for reference and reviewed with inspection results. A weldor's advice should be considered because of his practical experience.

Operational planning for welded fabrication can be difficult because heat conditions will cause dimensional changes for which allowances must be made. The amount of dimensional change can be minimized but never eliminated.

WELDS made on aluminum pedestal for drive base of radar antenna are visually inspected. To minimize inspection time, drawings, inspection instructions and check-off sheets should be studied first.

The extent of growth or shrinkage can be controlled by careful design, proper part assembly sequence, elimination of unnecessary weld joints, and reducing joint sizes to minimum for load requirements.

Further control can be obtained by staggering joints to introduce more uniform heat changes throughout, and wherever possible, subdividing the complete weldment into several sub-assemblies which can be welded as complete units.

Another important responsibility of the methods planner is setting the price to be paid for operation labor. To do this he must know the number of weld passes re-

QUALITY CONTROL WELDING INSPECTION REPORT (1)

MATERIAL _____ DRAWING NO. _____

TITLE

TYPE WELD _____ PLANNING NO. _____

PROJECT

A.Q.L. _____

PLANNED BY _____ DATE ____ SH. ___ OF ___ SERIAL NO. _____

DOCUMENTARY DATA - NOTIFY Q.C. IF ANY DEFECT IS FOUND IN THIS AREA (2)

DWG. LOCATION	DWG. DIM.	DIM. IS	DWG. LOCATION	DWG. DIM.	DIM. IS

OBSERVATIONS - DIMENSIONAL - ONE FOR EACH DIM. WELDING - ONE FOR EACH JOINT (3)

	ITEMS INSPECTED	DEFECTS-IF OVER MAX. NOTIFY Q.C.	MAX.
DIMENSIONAL			
WELDING			

ADDITIONAL INSPECTION - RADIOGRAPHIC, ZY-GLO - etc. (4)

TYPE	DWG. LOCATION	DISP.	ANALYSES	BY	DATE

DEFECT RECORD (5)

DWG. LOC.	DESCRIPTION	CORRECTION	RE-INSP.	CORRECTIVE ACTION

WELDED BY: _____ INSPECTED BY: _____ DATE _____

STATISTICAL ANALYSES (6)

APPROX. NO. LINEAR INCHES WELD = TOTAL WELD. OBSERVATIONS	DIMENSIONAL	WELDING
TOTAL OBSERVATIONS		
TOTAL DEFECT OCCURRENCES		
PROCESS OPERATION A.Q.L.		
PROCESS OPERATION DISPOSITION		

ANALYZED BY: _____ DATE _____

FIG. 1 — Sample outline which can be effectively used for recording inspection results of large weldments.

quired to complete a joint, and the joint length. This information is also important to the inspection planner for his analytical work.

The last member of the team is the quality control inspection planner who must thoroughly understand the design requirements, create an efficient recording method to document inspection results, and finally list and prepare for recording the locations where configuration changes due to welding might be expected.

This listing should include space for recording additional changes which cannot be predicted, but which becomes evident in the first welding assembly. The information is an effective guide for necessary dimensional changes to correct shrinkage and growth, and can be a future guide in the "do and don't" area.

However, this dimensional change information cannot be used to formulate a welding shrinkage rule since shrinkage in weldments is not uniform throughout.

Finally, the quality control inspection planner must prepare a planned inspection method including inspection instructions and check-off or inspection report sheets.

There are numerous check-off sheet methods in use, but maximum efficiency can be obtained when a universal type is used. Thus, the manufacturer can set up a regular procedure method and all personnel become familiar with one method.

Planning inspection must follow the methods planning sequence of operations. In this way the inspector is in a position to inspect and record results after each welding operation, thus minimizing the chance of accumulating defects.

The piece parts can be inspected for correct positioning immediately after the set-up-tack phase of the operation. The recorded inspection results, together with the results of similar inspections after welding, will indicate configuration changes caused by welding.

Analyzing this data, the quality control inspection planner can inform the design engineer where dimensional changes are advisable. The data also isolates cause-and-effect factors which often create confusion.

The quality control inspection planner should closely follow his project while in progress, and be constantly ready for discrepant conditions. He must also convince his associates of necessary revisions which do not appear significant to them.

To keep a running account of quality level for his project with an average degree of accuracy, the quality control inspection planner should make use of proper statistical quality control methods.

Figure 1 shows an outline which can be effectively used for recording inspection results of large weldments. With proper combined efforts of the inspection planner and the inspector, this report can provide much important information with a minimum of preparation.

A few of the items provided by this reporting method are:

1 — Evidence of inspection, defect correction and corrective measures applied to prevent reaccurance.

2 — Data pertaining to the weldment.

3 — Rapid "out of control" reporting.

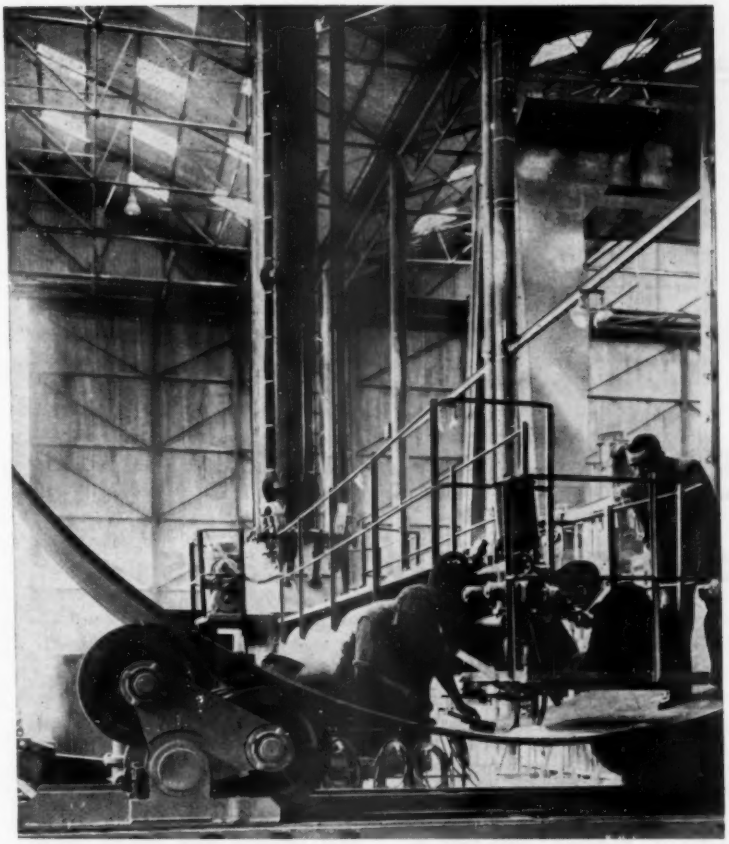
4 — Data necessary to establish acceptance standards.

5 — Data required to establish capability standards for the entire welding section or for individual weldors.

6 — Data necessary to assist in the scheduling of work.

With careful preparation, production of large weldment assemblies can be completed with a constant assurance of quality. But if the manufacturer expects to rush into production and confront problems as they present themselves, he may find himself cutting into contract money which could have otherwise been profit.

Big boom used to fabricate nuclear unit



SUBMERGED-ARC boom in operation over one of ten rubber-tired roller beds, which position and rotate cylindrical sections during welding.

CLAIMED TO BE the world's largest welding boom is the automatic submerged-arc apparatus at the site of the new Hunterston, Scotland, nuclear power station.

Scheduled for full operation by 1962, the Hunterston station uses nuclear reactors capable of producing an ultimate 320 million watts — enough electricity to supply about a quarter of the needs of the south of Scotland area. The reactors are cooled by carbon dioxide gas, which circulates through the nuclear core at a pressure of 150 psi and passes into 16 giant heat exchangers to produce steam for the electrical turbogenerators.

These cylindrical steel pressure vessels measure 73½ ft high, 19½ ft in diameter and each weighs more than 200 tons. They were fabricated at Hunterston by Motherwell Bridge and Engineering Co., Ltd., Motherwell, Scotland, using submerged-arc units from Linde Co., New York City. Work was done in a two-bay welding shop, each serviced by a 40-ton overhead crane.

The first bay is used for setting up and tack-welding the steel plates. The second bay, with two parallel sets of rails running down its length, is used for the automatic welding operations.

Two traversing and elevating welding booms, one of them the world's largest, mount four multi-power welding heads, two to each boom. Two transformers in Scott connection give a total current of 2,000 amp. Welding speeds are as high as 60 ipm.

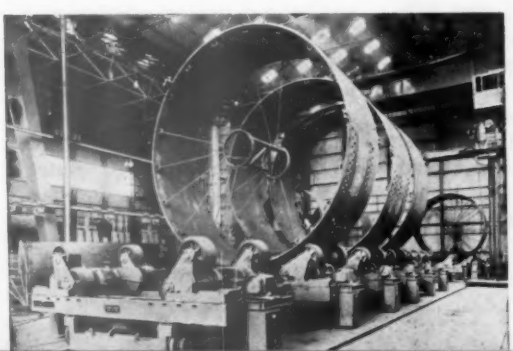
The boom operator is accommodated either sitting or prone at the welding head, where he has all controls for the welding, boom functions, and the traversing roller beds supporting the section being welded.

The booms have a high-speed traverse of 20 fpm for rapid positioning and both will raise clear for external welding of 20-ft-diameter vessels.

There are ten roller bed units, each of which can support a 20-ft-diameter vessel weighing up to 40 tons. Each roller can be individually operated, or any number may be multi-connected, under the control of a single operator.

Normally, the smaller boom operates at right angles to the axis of the section being welded, and is intended for external welding of the circumferential seams. The larger boom, 35-ft high and more than 22-ft long, will swivel through 360 deg, and can perform both internal and external welds. It is chiefly used for the longitudinal welds in the vessel segments.

Each pressure vessel is constructed from 6 cylindrical segments, plus a top and bottom head and a supporting skirt. The vessel is X-rayed during every step of fabrication. Then the complete shell is stress-relieved and hydrostatically tested, after which the final assembly is treated in a "clean conditions" chamber and dry-sealed until ready for erection.



HEAT exchangers in position on rollers in two-bay shop.

A *WE* news feature

From automobiles to missiles, space age metals are being developed and used at a fantastic rate, so . . .

Steel, aware of its competition, pleads its own case

THE STEEL INDUSTRY faces new competition and it will meet any challenge head-on.

This statement was made by Austin J. Paddock, president of U. S. Steel Corp.'s American Bridge Div., in a recent talk to the Engineering Society of Detroit. Making a case for steel, he singled out steel's achievements and the handicaps under which it is forced to work:

It's too bad that in the popular mind — and all too frequently in the mind of many engineers — steel is just plain, old garden variety, low-carbon steel. It has never been glamorized like the wonder drugs.

Actually, steel is as modern as today with almost unlimited end uses. A whole spectrum of steels extends from carbon steel to the indigo of T-1 and the royal purple of stainless. Yet too many people think of steel as unchanged since 1900, when it had a tensile strength of 60,000 psi and a yield point of 30,000 psi.

Today, our carbon steel has a yield point of at least 33,000 psi, 3,000 lb higher that it was then — and a new carbon grade with a 36,000 psi yield will soon be approved by ASTM. This new steel, considered fully weldable, appropriately will be numbered A-36.

One of the greatest advances in steel has been in structurals. In 1900, an alloy steel of 3.5% nickel with 90,000 psi tensile strength and 55,000 psi yield strength, was available.

But it was very expensive, *and was not weldable.*

Now, weldable, high-strength, heat-treated constructional alloy steels with a tensile strength of 115,000 psi and a yield strength of 100,000 psi (in thickness ordinarily used in bridges and building work) are commonplace.

These high-strength alloy steels are available in gages down to 1/8 in. for automotive, missile and manufacturing applications. In addition, other low-cost, high-strength structural steels in the 70,000 psi tensile strength, 50,000 psi yield class are readily available.

In other areas, new flat products have been developed that will, when treated, produce 200,000, 250,000 or even higher strength levels. How to use these steels most economically and efficiently should challenge designers and fabricators.

Unfortunately, their use should be more widespread. One limitation: the imagination and creativity of professional men who still think in terms of the standard carbon steels and whose designs never go beyond these possibilities.

In Europe, structural engineers usually work on a competitive basis. To succeed they have to get the most out of their materials and the best design out of themselves. In this country, the structural engineer is usually picked by the client.

A second handicap under which construction labors is the building codes — many of them drafted in an age when carbon steel was just about the only steel, and design knowledge was limited.

Many of the codes are hopelessly out of date. Those in one state prevent welding on bridge construction, which is as ridiculous as a legislature outlawing streptomycin. Another state insists on complete shop assembly of bridges.

Several others insist on elaborate rockers and expansion joints in a steel bridge span, but accept a neoprene pad and no expansion joint for bridges constructed of another material. And then they compare the costs of one against the other, although it's like comparing baskets of apples with bags of peanuts.

And steel must compete, not only with other materials in this country, but with our own materials in countries such as Japan, where one well-known engineer laughs and says, "The codes? I am the codes."

Not only in Japan, but in other foreign countries, engineers are designing so as to get the most out of their metals. Orthotropic and plastic design has taken hold of the imagination of Europe's structural engineers while these methods of design are barely launched in this country.

Right now at our research center in Monroeville, Pa., we are redesigning a 27-cu-yd dump trailer from the tires up — and tire manufacturers have already put steel cord into the tires, giving them a fantastic life.

Built of carbon steel, such a trailer would tip the beam at about 10,600 lb. Designed and built of aluminum, it weighs about 8,300 lb. That's usually as far as some people go when they start making comparisons.

By using carbon, high-strength and alloy steels, effectively and intelligently, however, we expect to get the steel weight down to less than 9,000 lb — approaching the weight of aluminum and still much stronger and considerably cheaper.

Consider the case of two beams of square tubing. The T-1 and aluminum beams have about the same weight and strength — but T-1 shows less deflection and costs only about one-half as much as the aluminum beam.

For a long time, we have been feeding you all kinds of tables and charts on the performance of our ten thousand steels. But you don't need cold data as much as you need specific suggestions of possible approaches you could take to put our steels to work.

One example is a booklet on allowable design stresses for high-strength and T-1 steels. This booklet is based on reports by our applied research laboratory, and it should inspire you to take a new look at steel as an engineering design for living.

(WELDING ENGINEER *described it and its usage in April,* 1960, How to weld T-1 steel, *p.* 38.)

What else are we doing?

We are selling in depth. We are making every possible use of our market and product development men, our commercial research people, our advertising and sales staffs. Their task will be to penetrate through the purchasing agent to the design engineer — in some departments, as far as the customer's salesman, because sometimes only he knows what the public is buying, and why.

New answers to problems posed by new designs for space vehicles, missiles, etc., are being found. One new stainless steel, which is still under extensive tests, shows a tensile strength of 250,000 psi at room temperature — more than four times that of ordinary carbon steel.

Other recent developments which have assisted our defense effort include: an ultra-high-strength steel with adequate ductility and toughness. With about 7% greater strength than steels presently being used, it makes possible a reduction in weight which is of importance to aircraft designers.

And one very high-strength, air-hardening steel with good high temperature strength is sufficiently workable to solve fabricating problems in the missile field. Years of laboratory research, backed by commercial processing and testing, have proved this low-alloy steel to be easy to fabricate and heat-treat.

Of particular importance to the missile industry, is the fact that it can be readily heat-treated and welded by conventional means already well-known to the industry.

Steel is supreme because of certain unique qualities it alone possesses in combination — versatility, high strength-to-weight ratio, hardness, resistance to corrosion and to temperature extremes, and ductility, which means the combination of toughness and elasticity.

Like the numerals one to zero, they are digits which can be combined with ten thousand steels to the point of infinity. Other products have one or more of these qualities. Only steel has them all.

Steel — ten thousand steels — that's our line.

. . . and plans an offensive

HIT COMPETITION from all areas head-on, application by application, customer by customer.

A few days after Austin Paddock gave his talk, U. S. Steel's president Leslie B. Worthington, in an address to the American Iron and Steel Institute in New York City, made this admonition to the steel industry.

He pointed out that rising living standards in other countries will provide a tremendous steel demand for manufactured goods and construction.

"A roaring market battle among the sellers of various materials goes on in boom times and slack times," he said. "This battle can result only in new kinds of selling effort on the part of each company. Meet the threat of competitive materials as they attempt to invade markets that can be well served by steel . . . do this realistically, with energy, with promptness.

"It isn't enough," he further stated, "just to hold someone in the organization responsible for being informed about competitive materials. Steel companies should establish and maintain contact with customers beyond the purchasing agents — with design groups, engineering departments, research organizations and even with the styling studios — in fact everyone who has something to do with the purchase of steel."

And the best way is "by more imaginative applications, greater emphasis on innovation, by specific, informative promotional programs and by intensive and comprehensive selling of our services and products.

"We can meet [competition] only by our being prepared to compete successfully in a society where every individual and every business enterprise has the right to choose freely in the market place the product which serves best."

STRESS relieving of welded pipe shows two halves of cable inductor pushed together. Operation is performed at 1,200 F; maximum power requirement is 10 kw at 2 kc.

Medium frequency induction heating provides precise heat control, mobility for stress relieving

by Werner K. Haessler
Brown Boveri Corp.

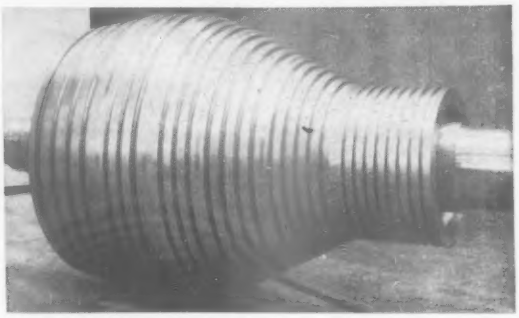
WELDING OF ANY METAL creates internal stresses which may result in cracks near the area of the weld. By proper preheating, slow welding and other techniques this can be prevented.

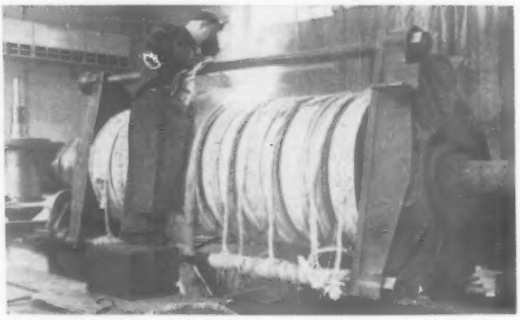
However, these internal stresses may have a more dangerous effect—creation of non-visible flaws, which may go undetected and later cause fractures, particularly in weldments subject to dynamic loading or sudden temperature changes.

This delayed-action damage is now recognized as the real reason for many breaks which previously were never fully understood or explained.

With this realization has come a greater emphasis on proper postheat treatment. Today, stress relieving is standard practice and specifically required for many workpieces, particularly where breakage could endanger life, such as high pressure boilers.

A postheat process capable of assuring weldments as flawless and stress-free as possible was needed, one which besides being versatile, would allow welds and forgings to be treated during erection at job sites and eliminate workshop annealing furnaces.





HEAVY steam turbine is built from several sections. The shaft is preheated, welded and stress relieved in a continuous operation without removing the inductor cable. In bottom photo, welder works on typical application.

Various methods, including gas or electric furnaces, resistance and induction heating, have been developed. In practice, these methods have various advantages and disadvantages.

The furnace is limited because of high cost, nonuniformity of temperature on the workpiece and lack of mobility. Electric resistance heating is not adaptable to weld or workpiece shape and needs relatively high temperature to produce the required temperature in the workpiece.

(*Ed. note — One manufacturer of preheating equipment has developed electrical strip heaters whose application is mainly on large, complex structures not readily moved or positioned, and on odd-shaped or contoured weldments where required temperatures range to about* 400 *F.*)

With induction heating, however, most of these drawbacks disappear. Heat is produced inside the workpiece; required power can be substantially reduced simply by covering the surface with asbestos;

equipment can be mobilized by housing the frequency convertor and all auxiliary components in a package; and precise heat control is assured by thermocouples.

Several significant technological and practical advantages are obtained through use of medium frequencies (1,000 to 12,000 cycles), and these moved European industry to generally adopt medium frequency for induction heating.

Low frequencies (usually 60 to 400 cycles) necessitated use of bulky, high-current-capacity inductors which, because they must be water-cooled, are limited in their applications. Job setups were cumbersome and difficult; a preformed inductor was needed for each application.

On the other hand, medium frequencies provide much higher power concentration, reducing the energy consumption as well as generator capacity needed for a given treatment. Heat is better concentrated; more energy is transmitted; and heat is produced with far fewer cable turns.

The last roadblock to full use of induction heating was removed with development of a highly flexible cable that can be used without any water cooling up to 1,200 F.

Because of its flexibility, the cable can be used as an inductor coil for small pipes and workpieces which before could be heated only with non-flexible water-cooled inductors. Now the workpiece is set up for treatment in a few minutes simply by winding the cable around the area to be heated.

Welding can be done with the cable in place permitting preheating before and stress relieving after welding with the same setup.

Temperature control prevents overheating and while the number of inductor cable turns and the required power can be calculated for any given treatment, there is no need for such calculations unless the unit is to be used at its maximum rating.

Induction heating can also be used for stress relief of large forgings. The advantages of the medium frequency system, with its precise heat control, are evident when working with forgings of geometrically complicated shape.

Another application of medium frequency induction heating is shrinking. A common industrial use is the shrinking of a gear wheel to a double-pinion shaft in which the coil is placed on top of the gear.

Induction heating uses the transformer principle. The inductor coil can be compared with the primary winding of a transformer; the workpiece with the secondary winding. The energy is transmitted electrically to the workpiece, heated mainly by eddy current.

Induction heating and stress relieving is, therefore, not restricted to metals of high magnetic permeability, although the required power to obtain a given temperature differs slightly depending on the character of the metal.

Using the same amount of power, induction heating with low frequencies requires high currents and heavy unweildy water-cooled cables. Or if normal currents are used, a very large number of cable turns.

Either way, rapid preparation is difficult and in some cases, totally impractical. Often there is insufficient space available to place the number of cable turns needed to transmit the required power.

Given the same energy, the induced energy increases roughly with the square root of the frequency.

The key factor is power concentration, *i.e.*, that power that is actually transmitted to the workpiece by a given length of inductor cable.

Comparing the values of 60 cycle and 4,800 cycle systems, for example, it is obvious that the power transmitted by the latter inductor is practically 10 times higher than that of the 60 cycle conductor for a given length.

Thus, considerably higher power concentration is obtained with the higher frequency or, conversely, that at least 10 times more turns are needed with the low frequency system to transmit the same power.

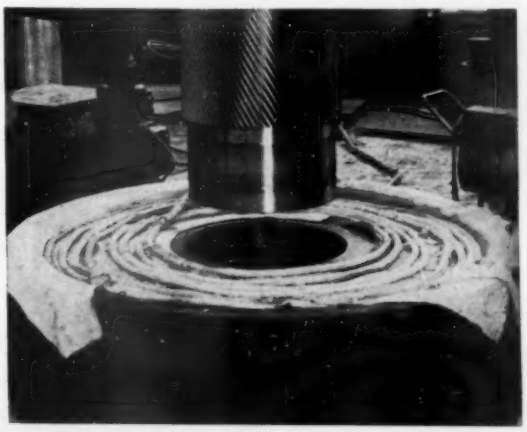
Due to wider distribution of the low frequency inductor cable, moreover, the power is also diffused. So, in order to obtain the required temperature at the location to be treated, considerably more total power, much of it actually wasted, must be applied when using low frequencies.

An evaluation of induction heating equipment, therefore, cannot be made on the basis of power only. A 100 kw, 4,800 cycle unit provides far more concentrated power and higher temperature than a low frequency unit of the same kilowatt rating.

The reason for the higher power concentration is the higher voltage drop at higher frequencies per unit length of inductor cable. As a result, the magnetic field is stronger and in turn, induces a higher current.

Simplicity of application is one of the main advantages of induction heating at medium frequencies. Although in general the choice of frequency is linked with size, thickness, material and shape of the object, a wide range of treatments can be performed economically with any given frequency.

Factors governing selection of a proper medium frequency unit and length of cable inductor can be computed by using the tables on the next page.



GEAR wheel is shrunk onto shaft in another application of induction heating. Insulation has been removed from wheel top to show inductor coil.

Computing power and cable length for stress relieving

Frequency (kc)	Diameter for circular seams	Minimum thickness in inches for steel heated to 840 F	1,200 F	1,700 F
1.2	1.6 — 10 ft	1/8	5/32	7/8
2.4	0.8 — 10 ft	5/64	1/8	15/32
4.8	0.4 — 5 ft	1/16	5/64	11/32
12	0.8 — 6 in.	1/32	3/64	15/64

Power required for treatment at:
840 F — 0.13 to 0.16 kw per sq in.
1200 F — 0.19 to 0.26 kw per sq in.
1700 F — 0.26 to 0.32 kw per sq in.

For proper stress relief three factors must be determined, required power, frequency and length of cable inductor. These can be computed by referring to the above table and the chart below.

Total power requirement for a given treatment can be calculated from the table which shows the power needed for each square inch of cross section of the workpiece. The total power requirement is obtained by multiplying the proper power value by the cross section in square inches.

For example, stress relieving at 1,200 F of a circumferential weld on a pressure vessel of 10 ft diameter OD and 2-in. wall thickness requires 0.19 to 0.26 kw per sq in. Selecting the median value of 0.225 kw per sq in., and considering that the cross section of the vessel is approximately 740 sq in., the total power requirement is 166 kw.

Next step is calculation of the length of the cable inductor. This can be done by means of the chart which shows for different frequencies the actual power transmitted by one foot of inductor as a function of the current.

Applying the required power arrived at in the above example, i.e., 166 kw, and considering a frequency of 2.4 kc and a current of 375 amp — the latter value being the maximum permissible current for the flexible cable — a power of 1.0 kw per ft of inductor can be transmitted. The approximate length of the cable conductor is then calculated as:

$$L = \frac{Pt}{p} = \frac{166 \text{ kw}}{1 \text{ kw/ft}} = 166 \text{ ft}$$

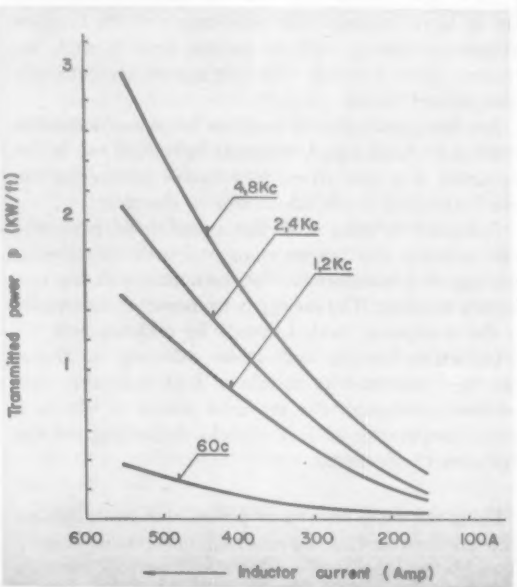
where L equals cable inductor length; Pt equals total power required for treatment and p equals transmitted power per foot of inductor according to the chart.

Since the circumference of the vessel is 31.4 ft, the number of turns is:

$$\frac{166 \text{ ft}}{31.4 \text{ ft}} = 5.3$$

Since only full turns can be considered, the required number of turns is 6.

The inductor turns can be connected in series or parallel if necessary to suit output of generator current and/or voltage. Most medium frequency generator windings can be connected in parallel or series. They can also be operated at constant output with increased current and lower voltage or the reverse.



OPERATOR uses Tig welder to join angle section along top of car.

FILLER plates are laid over the seam at an angle to eliminate sharp corners.

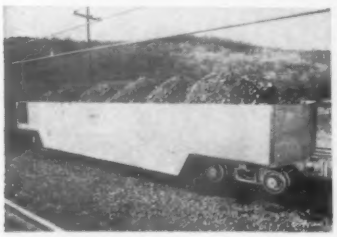
Mig, Tig welding builds aluminum mine cars

A WELDED ALUMINUM mine car — weighing nearly 50% less than conventional cars — is undergoing operational tests in a West Virginia coal mine.

The car was fabricated by Irwin-Sensenich Corp., Irwin, Pa., from 5083 aluminum alloy plate and 6061 alloy extrusions purchased from Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif.

Welding was performed by the Mig process, with 5183 welding wire used as the combined electrode and filler material.

Weight savings contributed by all-aluminum mine cars would permit an operator to haul additional 18-ton fully-loaded cars without increasing the normal gross train weight. Twenty three fully loaded cars of this type would weigh approximately the same as 20 loaded steel cars of equal capacity.



WELDED aluminum mine car weighs nearly 50% less than ordinary car.

In fabrication, precautions were taken to prevent the possibility of galvanic corrosion where the aluminum body is in contact with the steel undercarriage: zinc chromate primer was used on the aluminum surfaces; steel surfaces were cleaned, primed and given two coats of paint and a compound applied between the mating surfaces.

Weight of the car is 6,840 lb compared to 12,730 lb for a steel car of the same size. It measures 26 ft long, 7 ft 1¼-in. wide, and 4 ft 5-in. high. Capacity is 625 cu ft.

Another advantage claimed for aluminum in mine car service is its superior resistance to the corrosive action of the sulphur content of coal. The car is also expected to be less noisy in operation, and easier to re-rail.

A second company has also found aluminum plus welding an ideal combination for mine car fabrication.

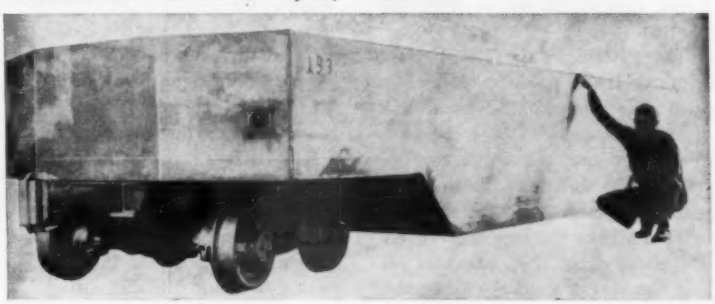
Watt Car and Wheel Co., Barnesville, Ohio, is filling an order for ten aluminum cars which will be tested at the Hanna Coal Co.'s Ireland Mine at Moundsville, West Virginia.

All required parts for the entire order were cut out before assembly started. Then each car was completely assembled and tack-welded before completing the seams. It took 10 days to complete the first car, but the third car was finished in only eight days, a reduction of 20% in fabrication time.

Tig welding equipment from Linde Co., New York City, was used in construction. A total of 1,300 ft of welding, mostly solid fillet welds, were used in joining the car's 90 aluminum parts.

Each car is 26-ft long, 7-ft wide, and 4-ft deep and weighs 7,580 lb. Cars are constructed of new aluminum alloy 6061-T6; most of the parts are 1/2-in. and 5/16-in. in thickness.

ALL-WELDED aluminum car has a capacity of 15 tons.



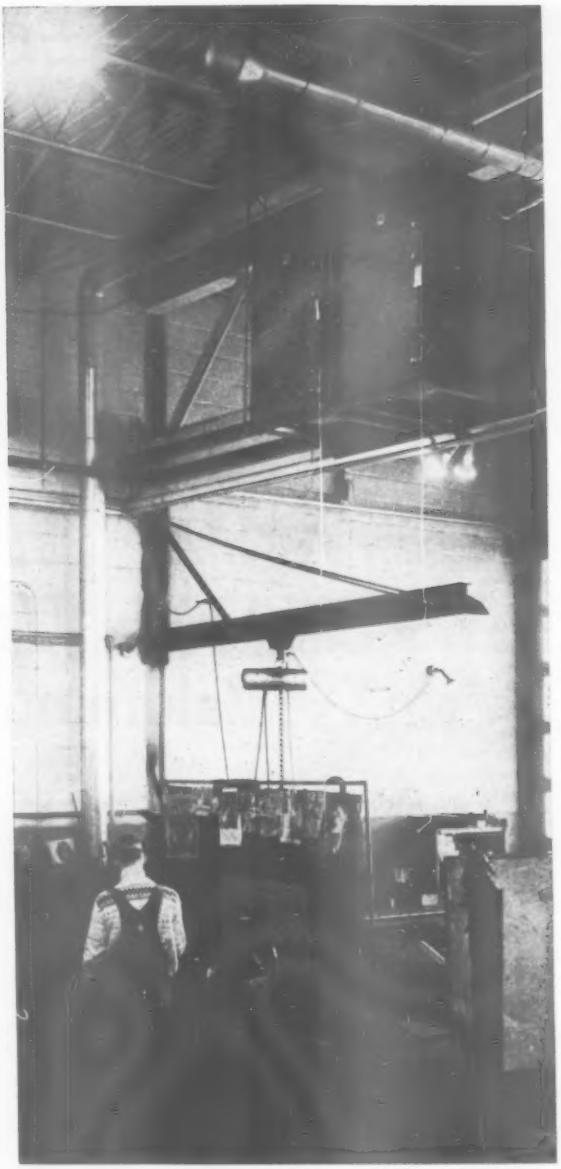
Dust units clear air, retain heat

RID THE AIR of offensive welding smoke, but still retain the heat in the air.

The first part of this objective is not difficult to achieve; most welding shops accomplish it simply by the use of exhaust fans.

The second part is not very difficult either, but neither is it being widely accomplished — not even in northern sections of the country where heat loss can contribute greatly to wintertime expenses.

In the welding shop of a Minneapolis manufacturing plant, where 30% of the company's personnel work, both parts of the problem are being solved through use of dust collection equipment uncommon to welding shops. Not only is the air being kept relatively free of the tiny particles and thick smoke generated by the arc welding process, but the heat-laden air is being retained in the building at considerable savings in fuel consumption.



ABOVE welding station are two of three dust collectors used in the Rosco plant. One of three intake pipes is shown at top center, while against wall can be seen one of the exhaust pipes, which transfers filtered air down to the floor.

Like most metal fabricators, Rosco Mfg. Co., a producer of black top road machinery, used exhaust fans to eliminate welding by-products from its shop. When the plant was enlarged and part of the welding operation moved to a neighboring building, dust collectors were installed on a trial basis.

This was 13 months ago. A plant spokesman claims Rosco's use of dust collectors is unique among Twin Cities welding shops. In addition to keeping air in the shop clear, these units quickly pay for themselves in fuel savings alone, according to Torit Mfg. Co., St. Paul, manufacturers of the apparatus.

The system in the Rosco plant employs three cabinet cloth-filter dust collectors and the usual link of 6-in. piping. What is perhaps even more unusual about this installation is that the collectors are suspended from the 20-ft ceiling. In addition to the space saved by this positioning, the collectors inhale the warmest smoke-laden air, rob it of impurities and return it through piping to the floor where it helps to keep the concrete slab warm.

Basically each collector is a self-contained unit consisting of a compact steel cabinet, filters and a motor-driven fan which moves 1,200 cu ft air per minute. Dust-laden air is drawn into the cabinet where particles fall into a dust tray or are trapped on outer sides of filters; filtered air is then drawn past the motor and exhausted.

A side benefit of the collection-purification system lies in temperature constancy — in adjacent areas as well as in the room where collectors are located.

The Rosco installation is a case in point. Located in a 60- x 80-ft room, which is approximately 1/3 the area of the entire steam-heated building, the collectors merely recirculate the warm air at the same temperature. They do not rob air and heat from adjoining areas where fumes are not especially offensive.

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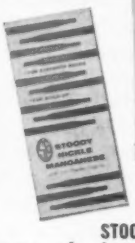

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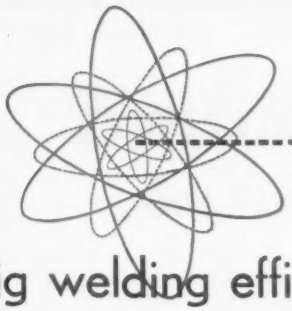


by **Stanley Donelson**
M & C Nuclear, Inc.
Attleboro, Mass.

Tig welding efficiency on reactor fuel elements upped from 99.75%

How do you improve a welding process that is 99.75% effective? By changing the welding variables and then testing and retesting.

One of the most difficult weldments to produce is the subassembly section of a plate-type nuclear reactor used as the main power source for ship propulsion.

Each subassembly has nearly 200 ft of welded seam and although actual specification requirements are classified, they can be compared to those imposed on the pressurized water reactor at Shippingport near Pittsburgh.

Flanged fuel elements are welded together along their longitudinal axis to form long coolant passages between fuel elements. This permits the water to cool the element surfaces. The welded seam, then, serves not only as the main restraint of the elements, but also to size the coolant channels.

These welds must meet the following specifications at all points along their entire length:

(1) Weld fall through cannot come closer to the edge of the fuel than 0.025. This, in combination with the allowable tolerances on fuel width and the subassembly's over-all dimensions, limits the greatest allowable drop through to approximately 100 thousandths.

(2) Welds must show visible evidence of 100% penetration. This is not easily done since it is difficult to view the weld bubble in a water channel slot only 1/16-in. thick, 3-in. wide and over 4-ft long. To be visible from the end of the subassembly, the weld bubble must be approximately 10 thousandths high and be irregular enough to be detected visually.

(3) Water channel width (*i.e.*, distance between opposite points of the weld bubble and sides of the subassembly) must meet maximum and minimum specifications.

(4) The welded wall cannot be less than the stated minimum. This, in connection with the subassembly's over-all dimension plus maximum channel width requirements, determines the original flange thickness to be welded, if no overlay is made to provide machining stock for further processing.

(5) Channel width for the entire core must have an average value within 0.010 of the nominal value.

In addition to the specification requirements, there are many physical difficulties. For example, shipboard reactor fuel elements are clad in Zircaloy 2 which has an extreme affinity for oxygen, nitrogen and hydrogen. Consequently, all hot processing must be done in vacuum or under a protective atmosphere, *i.e.*, drybox operation.

Weldments must be free of porosity, inclusions and shrink cracks or hot tears, particularly interior surfaces. In spite of the many restrictions and physical limitations, subassemblies were Tig welded in dryboxes under helium atmospheres with excellent results. Of the 200 ft of welding, only ¾ ft or 1.4 of 1% of the welds did not meet all specifications.

Unfortunately, this ¾ ft did not occur in one continuous length or in any one subassembly. This, in turn, could cause repair by rewelding or broaching out of excess penetration, sometimes in adjacent seams. Because of the expense, risk and delays involved in necessary repairs (each subassembly is worth more than $15,000) a better welding process was investigated.

The Tig process being used had been brought to its high capability by varying voltage, amperage, speed, and tip sizes and geometry. Several major and many minor modifications had been made on the welding equipment to lessen variability, including installation of seam followers for more accurate tracking of welded joints.

Information available from the Atomic Energy Commission indicated that increased welding speed might possibly reduce process variability. At the same time, helium supplies became restricted, so argon was chosen as the shield.

A series of seams, welded at various speeds in argon, showed that weld variability was greatly reduced at about 40 ipm. However, three subassemblies were satisfactory in all respects except one: the average penetration specification was exceeded by about 0.020.

Coupled with the fact that variability of each seam was on the order of plus or minus 0.030, this meant that weld beads were very close to the maximum size permitted, and in some cases, broaching was required to remove excess penetration.

Previous experiments had shown that a 2% decrease in amperage had reduced weld drop through about 0.005 on the average when welding in helium at 8 ipm. The same amperage decrease was then applied to this modified Tig method. Result: about 20% of the seams showed no drop through and required rewelding.

This incident is a good example of misapplication of engineering facts, *i.e.*, an inter-related set of conditions that operated at a particular level was assumed to operate in the same manner at a different level.

It was then left to a specialized group to investigate possible methods of improving welding results. The group consisted of a process engineer, welding engineer, an

AEC experiments with ultrasonics to join fuel elements

AN EXPERIMENTAL PROGRAM for application of ultrasonic welding to flat plate fuel element fabrication is being conducted jointly by Combustion Engineering, Inc., Windsor, Conn., and Aeroprojects, Inc., West Chester, Pa.

M. J. Whitman of AEC's Fuels and Materials Development branch reported on this program to the International Atomic Energy Agency in Vienna recently. Excerpts from his report follow.

Ultrasonic welding has been effectively demonstrated with many metals and alloys in both similar and dissimilar combinations.

Considerable experimentation has been conducted with aluminum and its alloys, and with several stainless steels, which have been welded in thicker gages than required for many flat plate fuel elements.

Although primary research has been devoted to spot-type welding, seam welding has been demonstrated by overlapping spot-type welds and by use of roller-type, non-intermittent welding equipment.

Ultrasonic roll bonding offers several advantages over other types of metallurgical bonding used in fuel element cladding. These welds possess high strength, are achieved with low external deformation and are essentially solid state bonds without the brittle cast structure of resistance welds.

The welds show excellent corrosion resistance and require minimum surface preparation. Temperature rise in the bond zone is extremely low.

Successful culmination of this research project would be a welding machine which would bond the cladding on full size aluminum, zirconium or stainless fuel element plates. The only preliminary operations required would be the stacked components properly placed on the welding machine table.

For fabricating zirconium alloy fuel plates, the jacketing with tinamel steel, evacuation of the jacket and repeated heating necessary for roll bonding would be eliminated. For stainless fuel plates, the edge seam welding, evacuation and hydrogen annealing would no longer be necessary.

The small amount of deformation involved would eliminate problems of oxide stringering in UO_2 dispersion fuel elements. The problems of maintaining core configuration would be lessened.

Unfortunately, a few serious problems must be overcome before the conceptual welding machine can be constructed. In order to provide the information needed to design the machine, a comprehensive development program is underway.

1 — A 4-kilowatt spot-type ultrasonic welder is being used to establish the power, clamp force and time requirement to weld X8001 aluminum alloy and 304 stainless steel cladding to various pertinent core materials. Cladding thicknesses of 0.010 and 0.020 in. and core thicknesses of 0.030 and 0.060 in. are being used.

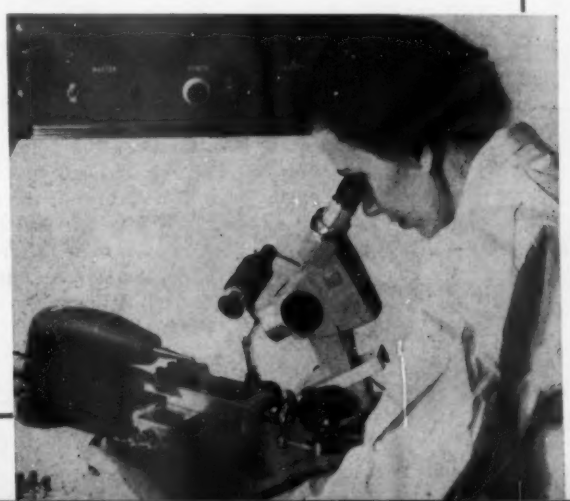
2 — Ultrasonic bonding of relatively large surface areas has not been intensively studied. An ultrasonic 2-kilowatt roller-seam type welding array has been assembled on a traversing table bed and used to prepare area welded surfaces for evaluation. Test procedures have been developed for evaluating the quality of surface bonds.

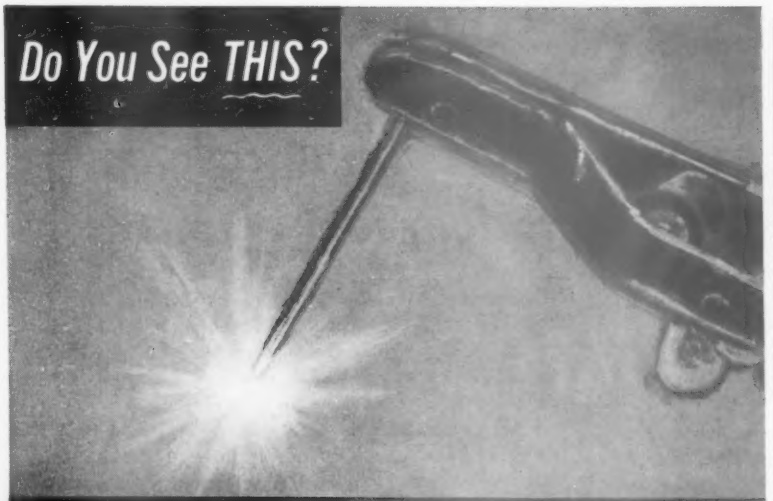
3 — Information obtained in the bonding parameter studies is being applied to the design of an experimental ultrasonic roll bonding machine which will make it possible to determine optimum width of a bond seam, and optimum welding speed.

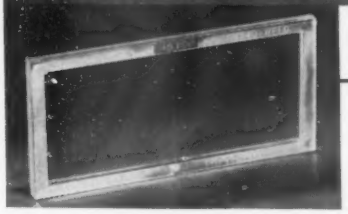
4 — The problem of edge bonding the edge strips to the cladding and core must be investigated and solved. A separate program is being directed toward establishment of satisfactory procedures for bonding edge rails or picture frames to the element core.

The development phase of the investigation will result in fabrication of sample stainless fuel element plates of a quality to warrant in-pile testing.

Test results coupled with an evaluation of the economic potential of this fabrication method would then determine whether the welding machine originally conceived can, or should, be constructed.







Ortho-Weld Lenses bring clear, sharp close-up view

Welders who wear bifocal lenses usually can't see well when the helmet is in working position; either they must work without their glasses, or, with glasses, the near-vision bifocal segment is out of the line of vision.

Ortho-Weld magnifying lenses correct this fault. By bringing work into focus they make operations easier, faster and more accurate.

Molded from crystal-clear lucite, Ortho-Weld lenses are inserted between the filter lens and rear cover plate of the helmet. They're available in 4 powers to fit the needs of most bifocal wearers: plus 0.75, 1.25, 1.75 and 2.25. Lens size is 2" x 4¼" or 2" x 4⅛". For more information, call your B&L supplier, or: Bausch & Lomb, 98707 Lomb Park, Rochester 2, N. Y.

BAUSCH & LOMB

SINCE 1853

electronics expert and a statistician.

Since the basic variables (joint geometry, other welding methods, specifications) could not be changed for one reason or another, a series of tests was begun to find the effect of varying welding speed, amperage, voltage and tip geometry.

A formula was established and indicated that the faster the welding speed, the less variable was the individual bead. In actual trial subassemblies, individual weld beads varied only 0.020 over their entire length at a welding speed of 40 ipm. Unfortunately, this gain was not made without a compensating loss — the average bead size could not be controlled.

Experiments in controlled conditions proved that by varying the main process variables at a set speed, amperage, voltage and tip size could be controlled sufficiently well to produce uniform weld beads of the proper size. The next step was to find the cause of the unstable welding condition.

Testing under controlled conditions showed that an individual weld bead would be started at the proper level and then abruptly change in size to produce a section of seam that was either too close to the fuel edge or too small to be seen.

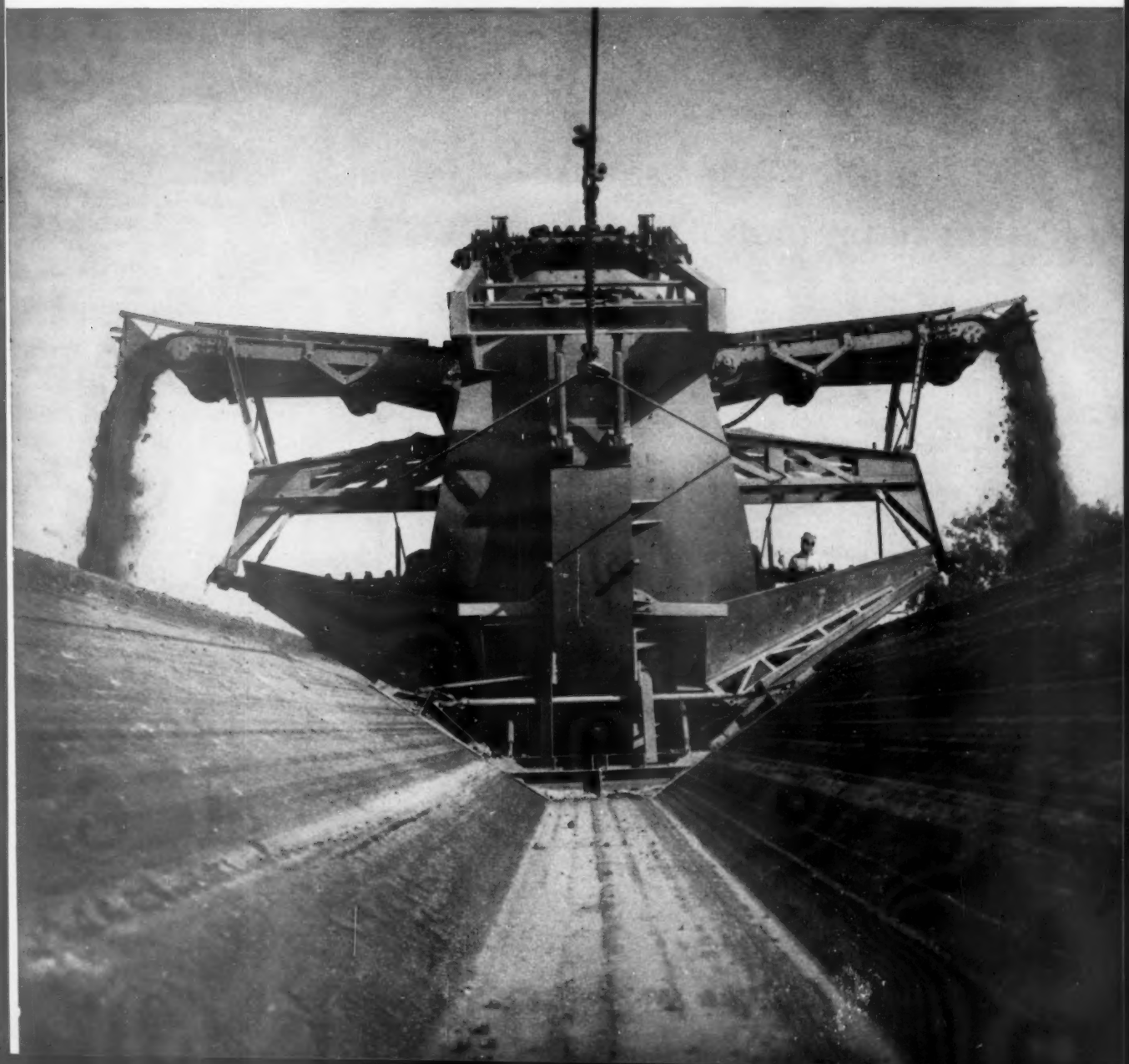
These abrupt changes were traced back to points where tack welds had been made on the subassemblies. The tack welds had sufficient effect on the instantaneous size of the weld pool to affect the size of the weld drop through when the seams were welded at high speed. By reducing the size of the tack welds and by staggering their location, a large number of these changes were eliminated

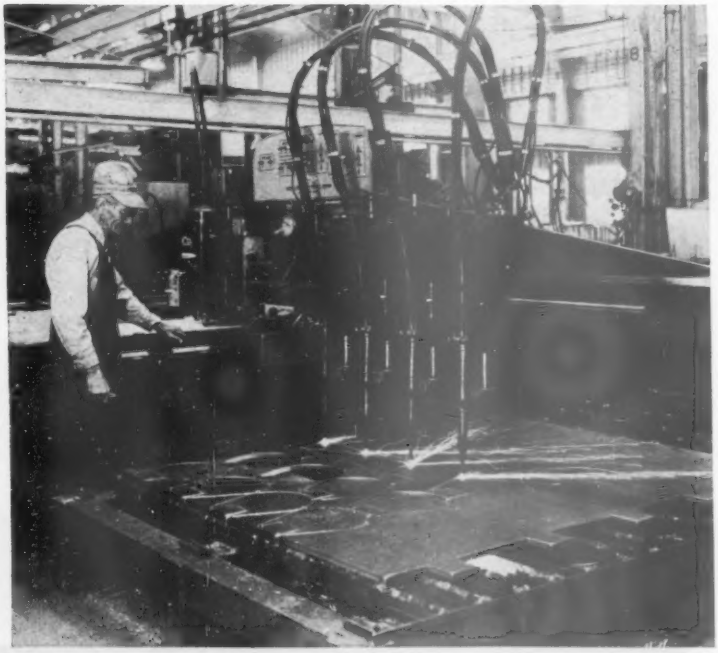
The modified high-speed Tig method has a total process variability slightly less than that of the original method. Since this process control has been obtained with a limited number of subassemblies compared to several hundred welded with the original process, further minor changes will bring the newer process entirely within specifications as fuel elements are produced.

World's fastest ditching machine welded with M&T Murex electrodes

This monster machine carves out a continuous ditch 6′ deep, 4′ across at the bottom and 22′ across at the top, at the rate of 7′ a minute. Working at its top capacity of 800 cubic yards of earth an hour, the ditcher could keep a large fleet of dump trucks mighty busy. To give its all-welded frame superior rigidity for uniform digging, Gar Wood Industries used Murex electrodes – products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

MUREX
PRODUCTS FOR BETTER WELDING





FOUR automatically controlled torches cut these parts to a tolerance of 1/32-in. At completion of each cutting cycle, operator advances torches to new starting point.

Automatic cutter saves firm time, money

BY REPLACING FOUR single-torch flame-cutting machines with an automatic, electronically controlled multiple-torch shape cutter, the Parkersburg Rig and Reel Co., Coffeyville, Kan., is realizing a savings of more than $10,000 per year.

The automatic machine, manufactured by National Cylinder Gas Div., Chemetron Corp., Chicago, controls torch motion by an electronic tracer which follows an ordinary pencil-line drawing, instead of the aluminum-strip templates formerly used.

The tracer consists of an electronic scanning device, a drive unit and a control panel. The optical scanning system follows the center of any drawn line 0.040-in. wide or less, within 0.005-in. on either side of the scanned line, at speeds up to 25 ipm.

Savings are attributable to three major factors: reduced labor, increased machine efficiency, and lower template cost. Four men operated previous flame-cutting machines. Now two men—one per shift—operate the automatic device, maintaining an even greater level of production since each of its four torches cuts about 15% faster than the single torch on the older machines.

Template costs have been lowered by approximately $640.00 per month. Formerly one man worked full time making plywood-base templates with aluminum strip edges; now one draftsman spends less than half his time making approximately 25 paper templates per month. The new templates are simply drawn in pencil and on plain white paper with the shape to be cut represented in full scale. Old templates were converted into drawings at approximately one quarter of current template costs.

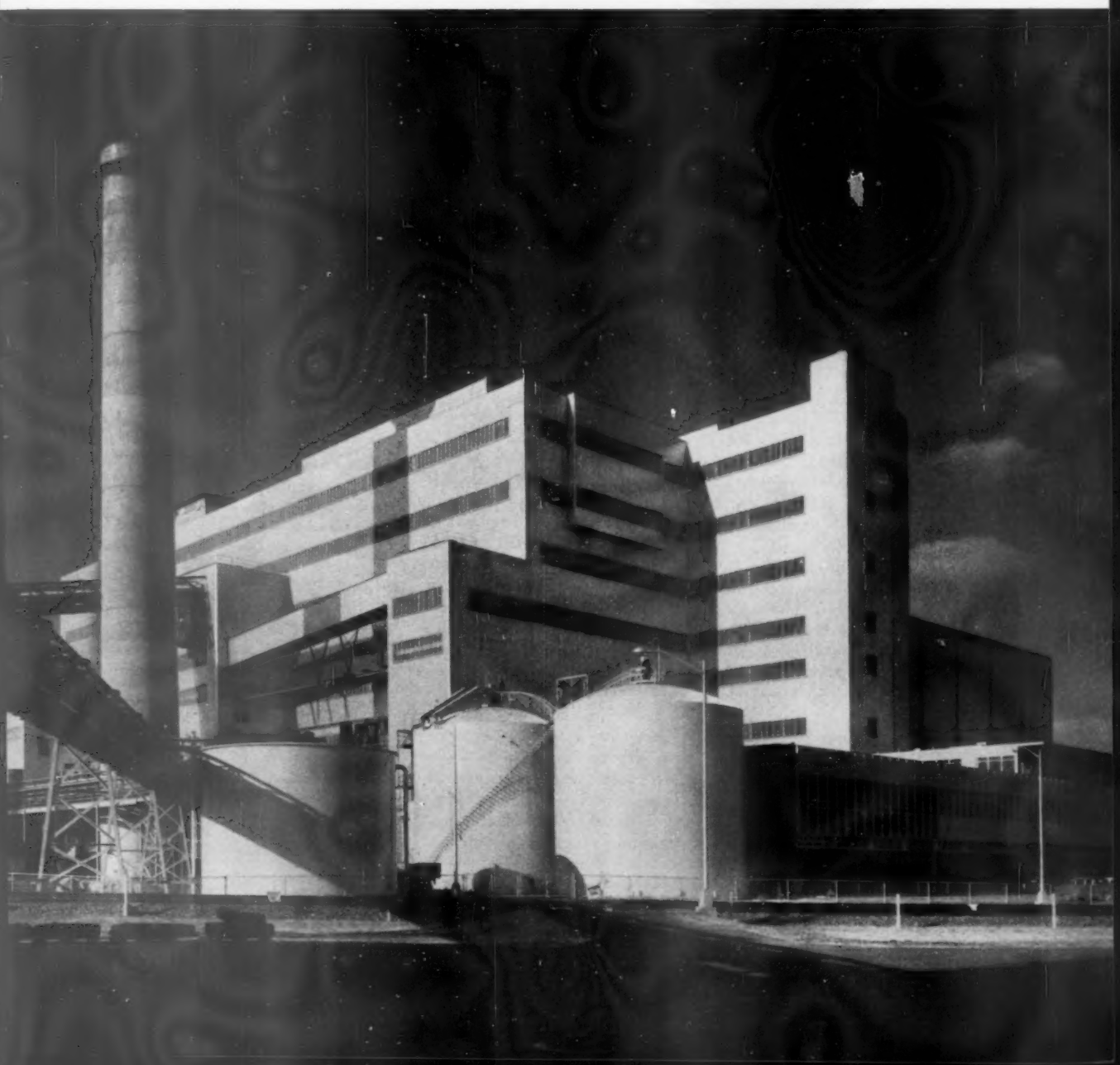
The templates can be stored in a drawer underneath the machine, where they take up little space and are immediately available to the operator. Before, the bulky plywood templates had to be stored outside the production area, often necessitating detailing a truck operator to bring a template to the machine. This sometimes took as long as an hour and a half.

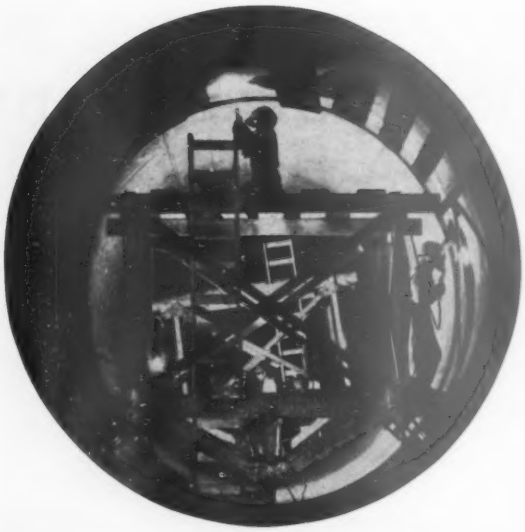
THESE plywood-base, aluminum strip edge templates have been replaced by easily stored paper templates.

World's most efficient power plant depends on M&T Murex electrodes

To get more electricity than ever from a ton of fuel, Philadelphia Electric's 325,000-kilowatt Eddystone No. 1 generating station superheats steam to 1200°F, 5000 psi pressure. No other power plant equipment handles steam at such high steam conditions. In welding most of the pipe for Eddystone, The M. W. Kellogg Company used Murex electrodes — products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

MUREX
PRODUCTS FOR BETTER WELDING





INSIDE circumferential welding between two 14-ft-diameter sections was done manually with E6010 electrodes.

ONE section of plate is in position in the assembly cradle, ready for tack welding to the adjoining bottom plate. Below, a completed can is pushed on a track into position for welding to the flow line.

All-welded pipeline replaces wooden aqueduct

by **C. W. Lytton**
District Engineer
The Lincoln Electric Co.

A LARGE DIAMETER, all-welded steel pipeline is now rushing water from Lake Wallenpaupack near Hawley, Pa., to Pennsylvania Power and Light Co.'s hydroelectric plant on the Lackawaxen River 3½ miles away.

The pipeline, reportedly the world's longest above-ground, is in two sections, one with a 14 ft 8 in. ID measuring 8,524 ft; the other (and newer), 14 ft diameter and measuring 9,300 ft.

Spans on the latter are 80 ft long from center to center of the supporting saddles and ring girders. Each span consists of two 38 ft 6 in. sections welded on a fitting bed at the job site before being moved in to the flow line for joining with a circumferential weld.

The aqueduct replaces an old line built in the mid-1920's of fir staves reinforced with steel rods. Frequent leaks made replacement necessary. When the first, or downstream, half was designed, some of the old piers and saddles were put to use, which required a 14 ft 8 in. diameter line.

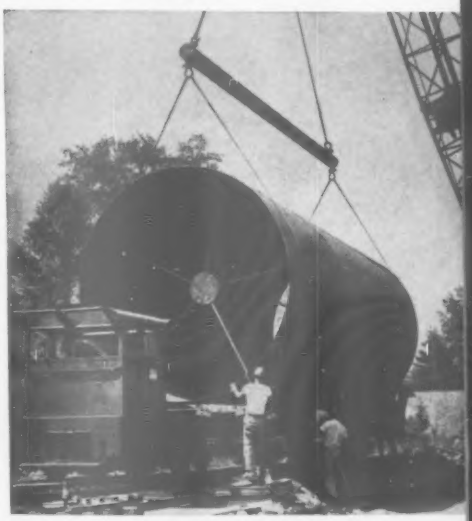
However, later experience showed that new piers and saddles with wider spacing would be better. Pipe thickness was also increased to 1/2 in. from 3/8 in. in this upstream half of the line.

Each pipe length or "can" is made up of five longitudinal sections of formed steel plate 38 ft 6 in. long. Procedure called for the two bottom plates to be set on the bed and then tack welded. Next, three assembly rings with bracing spiders were placed on the two bottom sections to support the three remaining plates for tacking.

With all five plates assembled, longitudinal welds were made on the outside in the 12 o'clock position using 1/4-in. E6027 electrodes. The pipe was rotated to bring succeeding joints to the top position by lowering the supporting saddles, turning on rollers.

Once the outside welds were complete, the inside welds were made with an automatic submerged-arc unit coupled to a tractor in the 6 o'clock position.

Assembly rings were fabricated with steel pipe stocks serving as spiders when segments of the ring were removed for welding on the inside. Plate edges were beveled by planing to form a double-Vee



RING girder (below) is lowered onto concrete piers. Rings are about 3 ft wide and set on 80 ft centers.

World's thirstiest flood pumps welded with M&T Murex electrodes

Some of the biggest pumps in the world are controlling flood damage in Florida's Lake Okeechobee area. With intake pipes 12 feet in diameter, they suck up swimming pool sized gulps of flood waters every second, spew it out into a series of reservoirs. Though not yet complete, the system has already prevented an estimated $44-million damage. The thirteen Fairbanks-Morse pumps in use were welded with M&T Murex electrodes—products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

MUREX
PRODUCTS FOR BETTER WELDING

MEETS RIGID SPECIFICATIONS

HARRISBURG CYLINDERS

Among the many reasons for longevity and dependability of Harrisburg cylinders are the rigid tests and inspections to which the cylinders are subjected.

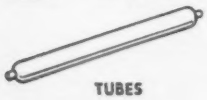
For example maximum control of cylinder wall thickness is attained through the use of an XactRAY Gauge. This instrument is used to measure wall thicknesses throughout the length of the cylinder shell. In addition to the XactRAY gauge; Vidigages, Sonigages and Magnaflux Testing are available for use as required.

These instruments, of course, are supplementary to exhaustive I. C. C. inspections and tests which make possible effective control of wall thickness for minimum weight consistent with maximum service life.

More than a Century in Harrisburg 8, Pa.

H HARRISBURG STEEL CO.

Division of HARSCO CORPORATION



TUBES

TRANSPORTS

FLANGES

COUPLINGS

with a 90 deg included angle and a 1/8-in. root face.

On the inside automatic welds, 1/8 in. mild steel wire was used at 650 amp, 37 volts with a travel speed of 109 ft per hour. Flux used was a neutral type because it was considered best for outdoor use where danger of rust and moisture existed.

After the sections were welded, they were transferred to the flow line on low-bed trailers, except where overhead obstructions prevented easy crane unloading. In this case, the sections were set on dollies on a rail line and pushed into place.

Large ring girders were produced in two halves from rolled sections in the fabricating shop and welded together manually in the field. Long-boom cranes helped turn the girders so the joints could be in the flat position.

The ring girders are on 80 ft centers. Two pipe sections were moved into the line and tack welded together and to the rings, both girder and pipe being beveled so that a 60 deg included angle with a 1/8-in. land was on the outside.

The first finishing pass was made on the outside using a 5/32-in. E6010 electrode to give the easiest weld to chip from the inside. Subsequent passes were made with 3/16-in. E6010's.

After the outside welding, a light pass was made with a chipping hammer on the inside and then a 5/32-in.-diameter E6010 electrode was applied for the finish pass. The smaller electrode was selected because the buildup on the inside was restricted by specifications.

Welding equipment was moved along the line on flat-bed trailers for speed and convenience. A tractor expedited longer movements of the trailers.

The entire project, designed, fabricated and erected by Bethlehem Steel Co., was completed in record time and across some very rugged terrain. There are no expansion joints in the entire line since rotating and self-relieving anchors compensate for expansion and contraction.

HERE water purification unit is being employed in the field.

Army Engineers use Mig process to build airborne water purifier

A GOOD EXAMPLE of welding's use in national defense is an air-droppable water purification unit lately developed by the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va.

The 600-gal per hour unit is one of a family of three mobile units designed to purify radioactively contaminated as well as ordinary polluted water.

Heart of the unit is an "Erdlator," a conical welded aluminum tank in which mud, bacteria, and other suspended matter in the water are coagulated and removed. Polluted water can be converted to potable liquid in less than 25 minutes.

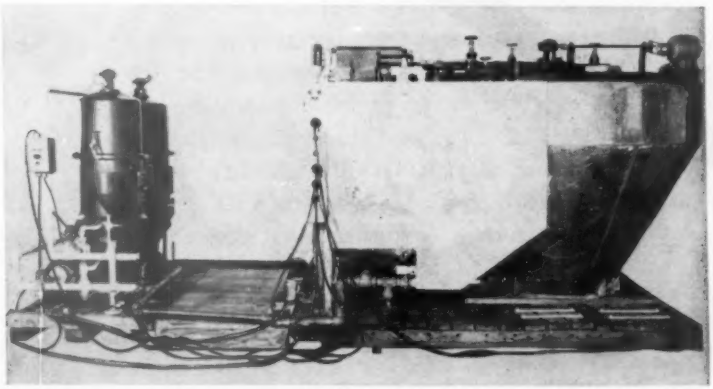
The tank is made of 3/16-in.-thick aluminum and stands 8-ft high, with a 14-ft major diameter and a 4-ft minor diameter. After edges were filed and cleaned, the unit was Mig welded using 1/16-in.-diameter filler wire in an argon atmosphere.

Ninety per cent of the welding for the Erdlator was done in the shop and 10% in the field.

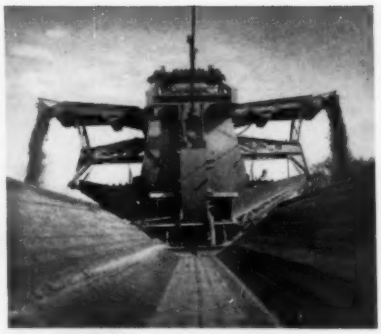
The finished product is mounted on a special 1½-ton drop-frame type trailer chassis. The cargo body is removable from the chassis should the latter be damaged.

Filtered water is stored in two collapsible, fabric tanks, each weighing approximately 110 lb.

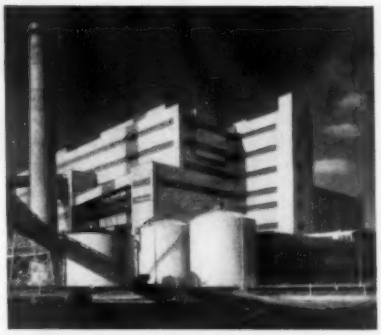
Sectionalized to facilitate transport and handling, the airborne unit includes a water treating section, a water filtering section, and operating accessories such as pumps, hose, generator and chemicals.



BASE-MOUNTED water purification unit developed by Army Engineer laboratories.



World's Fastest



Most Efficient

Most Thirsty

The fastest ditcher in the world ... the most efficient power plant in the world ... some of the biggest pumps in the world ... all were joined with M&T Murex electrodes. These electrodes always seem to turn up on the important jobs ... the ones that win engineers' admiration.

There are over 1000 types and sizes of Murex electrodes ... one of the broadest lines of electrodes and wires for arc welding ... with stocks and service offices in every major manufacturing area. Send for free Electrode selector.

M&T welding products

METAL & THERMIT CORPORATION
General Offices: Rahway, New Jersey

When you see an eight-eyed spider...

call an *ARANEOLOGIST*

(specialist in spiders)

when you've got welding problems... call in *LINCOLN*

(specialists in arc welding)

A SOUTHERN sheet metal fabricator had "burn-thru" in the welds. The LINCOLN Field Engineer recommended Fleetweld 37 and licked the "burn-thru" problem. But more important, the new electrodes increased welding speeds to such an extent that overall costs dropped a third.

And right there is a good reason for doing business with LINCOLN. Ideas to whip knotty production problems come naturally to the Field Engineers. They are factory-trained where they—and everyone else—gets paid according to his individual contribution to the company's goal—superior products and service to you at continually decreasing costs. So, while he knows welding, he also understands how to relate it to your total manufacturing operation.

That's why we say it's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a "plus" at no charge.

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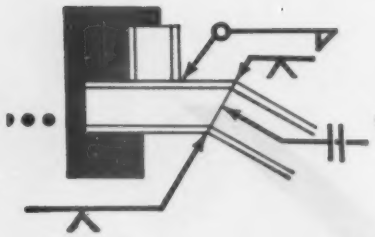
LINCOLN ELECTRODES



the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Welding procedure for repairing cracked tools

Question:

Can you suggest a good welding procedure for repairing cracked dies and other tools?

Answer:

Too often, repairs on heat-treatment cracks or fatigue cracks on dies are made by welding a single bead on the surface of the tool, along the visible course of the crack.

Such a procedure is hopeless. Instead of welding the crack throughout its depth, it merely tack welds the surface. Tools welded in this manner rarely last long enough to do any useful work.

However, welding of dies to incorporate design changes or repair of localized operating damage is often a necessity. All tools or dies made of any tool steel grade can be welded successfully if the proper procedures are used.

The following steps, suggested by Bethlehem Steel Co., should provide satisfactory results.

(1) Full-anneal the tools. Good atmosphere control is necessary to avoid scaling and decarburization of working surfaces.

(2) Prepare the cracks for welding by "veeing" out their full depth and length.

(3) Use a welding rod which will deposit steel of the same composition as the tool.

(4) Preheat to 400-800 F and maintain this temperature during the welding operation.

(5) Clean the slag from each bead before proceeding with the next.

(6) Immediately after welding, transfer the tool into a furnace at 400 F minimum and then full-anneal as in step one.

(7) Machine or grind the weld to desired tool dimensions.

(8) Heat-treat the tool by quenching and tempering to the desired hardness, using the standard procedure for the grade involved.

(8) Grind the working surfaces of the tool. The depth of metal removal will depend on the amount of decarburization produced in steps one, six and eight.

Following this procedure will permit successful welding of tools. However, in some cases, it will be more economical and quicker to make up new tools by conventional procedures.

When emergency welding is done on a production line, it is often necessary to eliminate many of the above steps, thereby reducing the chances of producing serviceable welds. The success of emergency welds depends on many variables, such as the grade of tool steel involved, size and shape of the tool, size and location of the area to be repaired and the skill of the weldor himself.

Question:

Do you have any information on products available for placing in gasoline or fuel oil tanks to make them safe for welding?

Answer:

Although WELDING ENGINEER does not recommend it completely, dry ice or carbon dioxide in gaseous form is sometimes used to provide an inert atmosphere in fuel tanks that are being repaired by welding. In most cases, this is used as a supplementary process.

Most weldors rely on a steam purge for a time long enough to insure complete safety, the time element depending on the tank size.

There is a chemical cleaning process which also utilizes steam to a degree, but it has proved no better than straight steam cleaning. The American Welding Society has a standard called "Safe practices for welding and cutting containers that have held combustibles," and can be purchased by writing to 33 West 39th St., New York 18, N.Y.

Question:

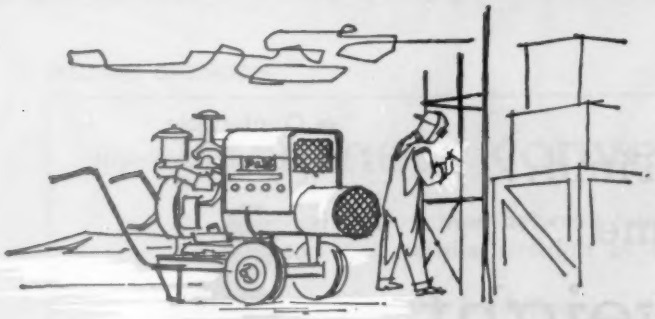
We have recently begun production of galvanized parts but are having trouble welding them. Can you offer any suggestions?

Answer:

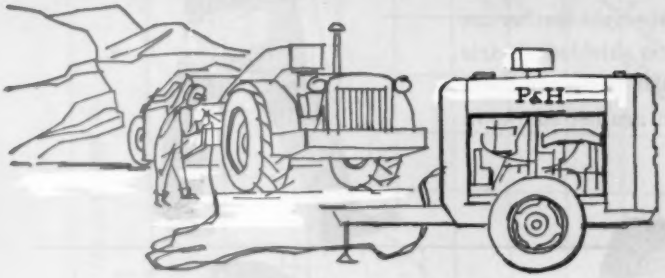
Difficulty in welding galvanized surfaces can be avoided by masking the weld area with a solution of potassium dichromate and hot water prior to galvanizing.

The solution is being used by Westinghouse Electric Corp.'s lighting division to leave a clean surface for welding on the bottom of transformer tanks. After welding, the ungalvanized surface is shot-blasted and zinc-sprayed.

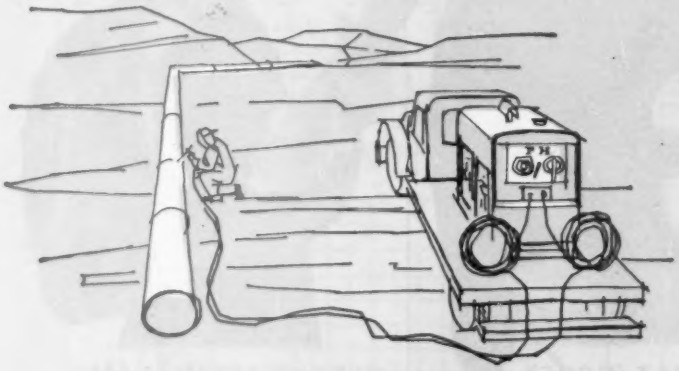
The masking solution consists of 32 ounces of potassium dichromate and one gallon of water. It is applied at a temperature from 120 to 140 F and is allowed to remain in contact with the metal for two minutes. The surface is then dried before galvanizing.



eliminate rewelds



and callbacks



6 engine-driven models for field welding in the 25- to 500-amp. range

Put your out-of-shop welding on a paying basis by welding the job right the first time. You can do it with portable, self-contained P&H engine-driven welders.

Here's why: Accurate voltage control enables operators to make precise settings and re-settings without "jockeying" or other adjustments. Superior current stability — even at extreme ends of range — permits deep penetration without burn-through. Instantaneous recovery maintains 100% arc stability throughout the welding cycle, thus preventing popouts.

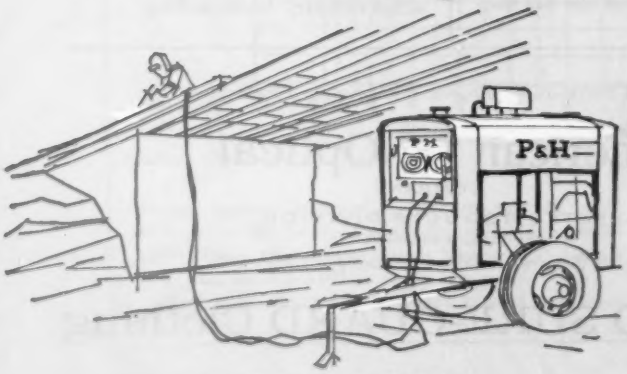
The built-in controls simplify welder operation. They enable operators to weld faster — and to lay down stronger, cleaner welds the first time. As a result, there's no need for rewelds or costly call-backs.

P&H welders are built to give long-life, low-cost welder service — to withstand hard use and rough handling in the field. They need less care because all non-essential parts have been eliminated. Powerful gas or diesel engines permit full-shift operation with fuel to spare.

Pick the P&H welder you need from industry's most up-to-date line. Six models, skid- or wheel-mounted — with manual or electric starting. Write for Bulletin W-158.

918

with P&H portable welders



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AO Lightweight
Welders' Clothing!

These very comfortable garments of lightweight leather are recommended for welders working on gas shielded electric welding where Argon, Helium and similar gases are used. They should not be used for protection against sparks in electric arc welding.

CAPE SLEEVE WITH DETACHABLE BIB (C208B)

Special soft, flexible leather protects chest and arms from harmful rays. All seams cotton stitched. Seam ends reinforced with steel rivets. Bib attaches to cape front by snap fasteners. 5 sizes.

NOT ILLUSTRATED — SHORT JACKET (C203). Jacket is 18″ long.

26″ COAT (C206)

For welders who prefer to weld in a very lightweight jacket. Seams are double thread sewed. Snap fasteners down front. Snap fasteners on each sleeve for snug fit (nickel plated for heat reflection). Pocket also has snap fastener for security.

SLEEVE 18″ INSEAM LENGTH (C209)

Double thread sewed seams, snap at cuff. Leather thong around neck holds sleeve secure. The lack of unnecessary weight pays off in greater comfort, added efficiency, better welding.

Always insist on Trademarked Safety Products

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COMPANY
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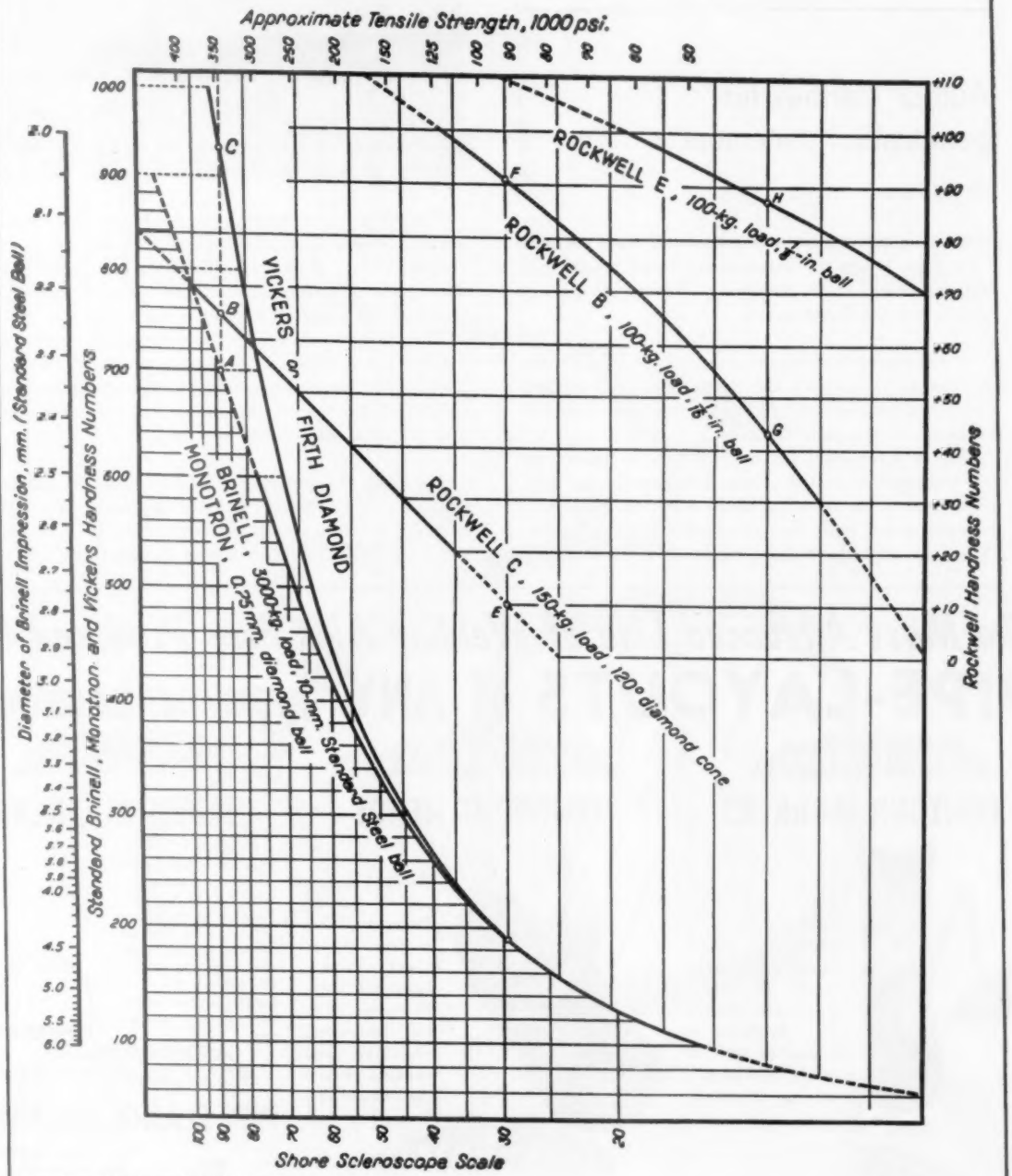
Your Surest Protection...AO SURE-GUARD Clothing

Hardness conversion chart

Approximate relation between hardness by various testing systems and tensile strength of carbon and alloy steels



Courtesy The Babcock & Wilcox Co.

Verticals represent equivalent hardness. For example, Brinell or Monotron 700 (point A) equals Rockwell C-65 (point B), equals Vickers 930 (point C), equals Scleroscope 89 (bottom scale), and about 340,000 psi tensile (top scale).

Again, Rockwell B-91 (point F) equals Rockwell C-10 (point E), equals Brinell, Monotron or Vickers 187 and Scleroscope 29, and has about 92,000 psi tensile strength.

Finally, Rockwell B-43 (point G) equals Rockwell E-87 (point H). Chart is based on data from Westinghouse Research Laboratories, Bureau of Standards, ASM Metals Handbook.

Mr. Ronay's statement in the March WELDING ENGINEER that straight polarity gives twice the penetration of reverse polarity prompted several notes from our readers. His reply to these queries follows.

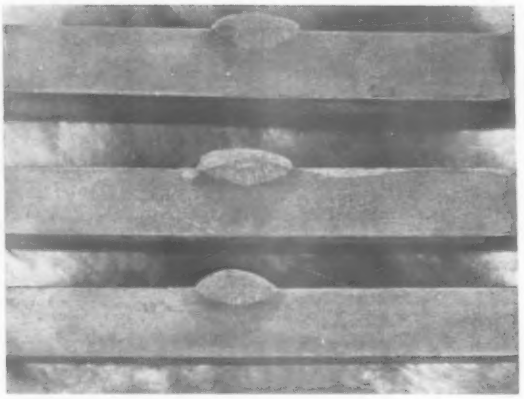
Author clarifies his penetration statement

by **Bela Ronay**

THE TERM PENETRATION is a holdover from the bare wire days. When we began scientific examination of the phenomena of arc welding, we learned that penetration is not a linear value.

It was found that proper evaluation of an electrode as regards melting off the base metal as it obtains under optimum current and progression rates, should be based on the penetration ratio.

This is determined for single beads, as shown by the macrographs in the photo. The penetration ratio is the area of the remelted metal under the plate surface compared with the entire area of the deposit, *i.e.*, under and above the plate surface.



Placing a transparent graph sheet over the macrographs, anyone can determine quickly that the penetration ratio at straight polarity (top) is better than for reverse polarity (middle). For a-c (bottom), the value of the penetration ratio is near unity.

The condition shown on the macrographs are typical but not absolute, in that by manipulation of the angle of the electrode's incidence above the plate, the pattern of the penetration ratio may be influenced and the effect of polarity neutralized.

The electrode used was a 3/16-in.-diameter E6020. Current rate for reverse polarity deposition was 170 amp, 5% more for straight polarity and 10% more for a-c. Progression rate was 6 ipm for all three beads.

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PIPE-LAYOUTS of ANY Type or Location

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Marks off any pipe joint or structural angle cut accurately, easily and without figuring cutbacks. Marks all around pipe—saves time and gas. Available in 2 sizes of 1½" to 18" in cross-section, 16" to 48" diam.

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An easy way to find accurate angles on pipe and structural material. A valuable aid to weldors, structural workers and pipe fitters. Size 4" x 8"

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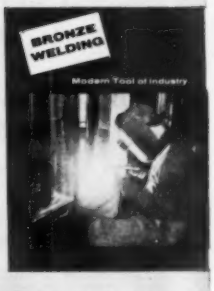
things like tricycles and bicycles for junior's play. Whatever your application, in building or maintenance, look for the rod with "Bridgeport" stamped on it. Strict laboratory control assures dependable performance. Every Bridgeport welding alloy tins easily... flows freely and produces dense, sound, non-porous welds of uniformly high strength and ductility. It's available in standard rod sizes and lengths, and coils or spools for automatic equipment. Call your local distributor.



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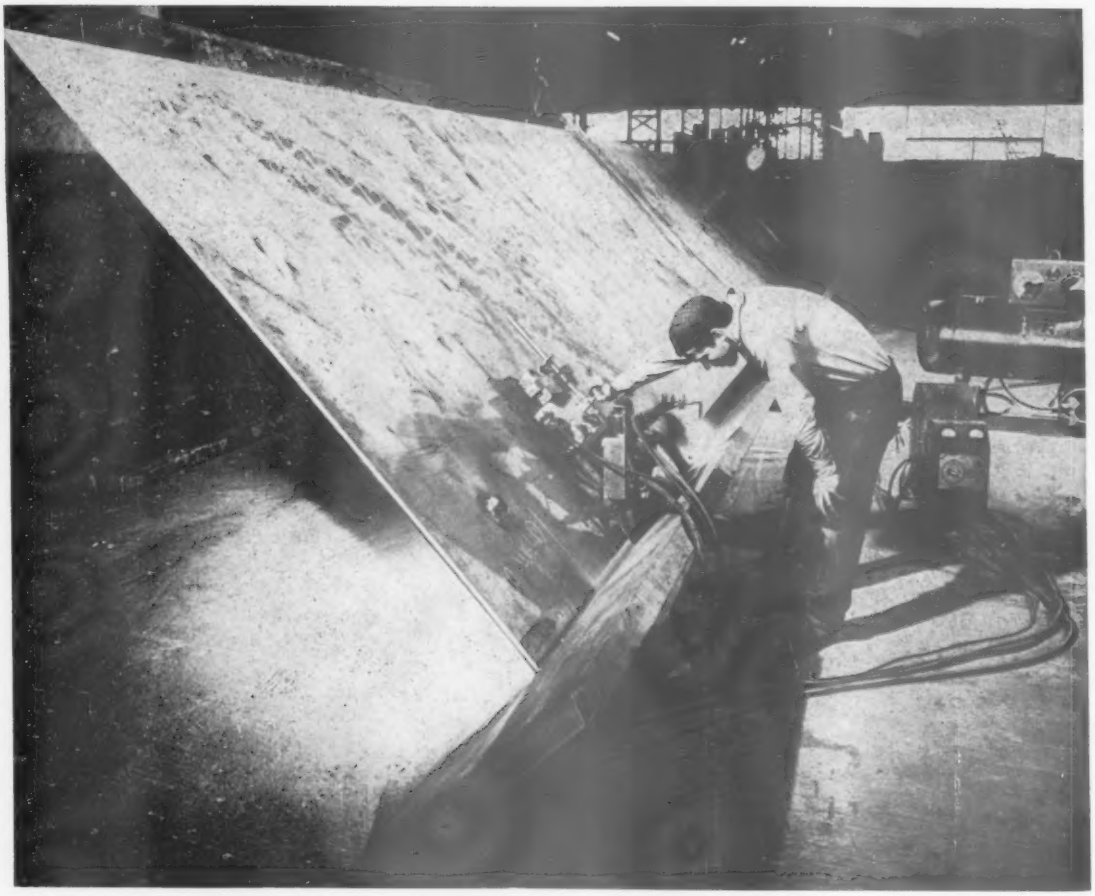
Specialists in Metals from Aluminum to Zirconium



HUGE 375-ft main span girders for the new Nisqually Glacier Bridge at Mt. Ranier National Park, Wash., undergo submerged arc welding at West Coast Steel Works, Portland, Ore. Two-pass procedure is used with Lincoln Electric Co.'s unit to insure deep root penetration in continuous ½-in. fillets.

On the job...

TO provide inert-gas shielding within pipe joint for 154 Tig welds, two air balloons were inflated, one on either side of joint, and argon was pumped in to displace air. Work was done by Pittsburgh Piping and Equipment Co., Pittsburgh, for expansion of Cleveland Electric Illuminating Co.'s Avon Lake, Ohio, power plant. Equipment used was that of Linde Co., New York City.

A Model 1061 Multitron radiographing a large steel valve casting at Pacific Southern Foundries, Inc., Bakersfield, California, a subsidiary of Pacific Valves, Inc., Long Beach, California. Model 1061, a 1000 curie-cobalt 60 source, features fully automatic fail-safe protection and remote operation from a console control center. The special mounting stand was designed and fabricated by Pacific Southern Foundries, Inc. and Pacific Valves, Inc.

SAFE!... Budd Multitron® and Iriditron® Units for Gamma Radiography

- **Hermetically sealed sources are under positive control at all times**
- **Shielding for sources is latest design**
- **Source position indicator shows exact location of source**
- **Fail-safe mechanism returns source to shielded head if power fails — on all units having electric drive**

Maximum safety with minimum weight: that's the story of Budd radiography equipment. You can select the equipment that best fits your requirements from the 21 standard Multitron and Iriditron models now available. One of the Budd models will give you the method or methods of exposure, number of sources, source materials, strength and types of mountings you need . . . all with maximum safety.

Budd offers complete service—radioactive source supply and encapsulation, source replacement and disposal, training for your personnel (at no charge) and assistance in setting up complete radiographic facilities.

Contact Budd Instruments Division for new Gamma Radiography bulletin . . . or for a consultation on your requirements.

INSTRUMENTS Budd DIVISION

THE BUDD COMPANY · P.O. Box 245 · Phoenixville, Pa.

Consult your phone book for sales offices in: Atlanta, Ga., Oak Park, Ill., Dallas, Tex., Los Angeles, Calif., San Francisco, Calif.
In Canada
Tatnall Measuring and Nuclear Systems, Ltd., 46 Hollinger Rd., Toronto 16, Ont.

News Shorts . . .

Pressed Steel Tank Co., Milwaukee, Wis., manufacturer of shells and missile components, compressed gas cylinders, and other containers, has moved its New York City and Chicago offices to new locations. The New York office is now at 1199 Main Ave., Clifton, N. J., and the Chicago branch is at 6634 N. Western Ave. . . . Available through local sales offices of **Linde Co.**, New York City, is a 9-minute, 16-mm sound and color film entitled "Unionarc Welding in Industry," explaining the fundamentals of the CO_2 flux-shielded process . . .

Contracts for construction of a one-story factory and office building containing a total of 50,400 sq ft have been awarded by **Black & Decker Mfg. Co.**, Towson, Md. The building, to be of unitized construction at a cost of approximately $700,000, will house manufacturing facilities for **Master Power Corp.**, a subsidiary of Black & Decker . . .

R. G. LeTourneau, Inc., Longview, Texas, will furnish key components and technical guidance to the Italian government in its plans to step up its offshore oil drilling program with a new mobile drilling platform. A $1 million contract was signed for construction of the three-legged structure . . . **American Emery Wheel Works**, Providence, R. I., recently removed its Detroit district offices and warehouse to Warren, Mich. . . . The **Resistance Welder Manufacturers' Assn.** received an informal presentation from Prof. Roy B. McCauley, chairman of the department of welding engineering, when that group visited the campus of Ohio State University recently . . .

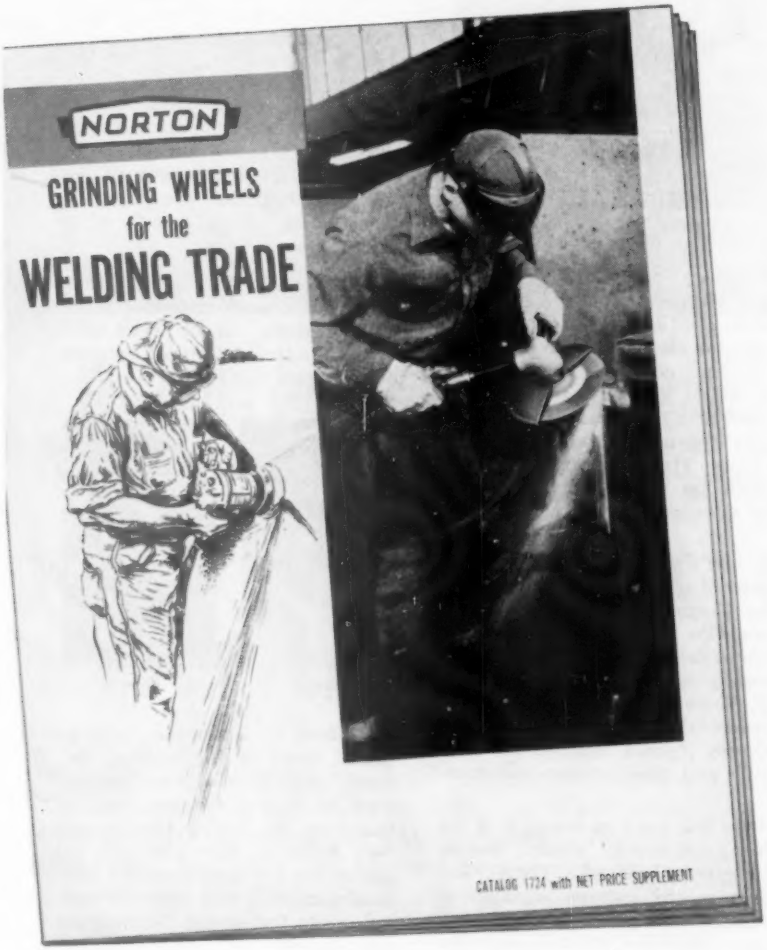
Plans have been completed by **Syntron Co.**, Homer, Pa., for construction of a new manufacturing plant for silicon rectifiers that will increase the firm's production 8 times the present capacity. The new air-conditioned factory will add 16,000 sq ft of area to present operations, will include a dust and humidity control system . . .

Recently previewed was a highly automated rolling mill at the South Chicago Works of **United States Steel Corp.**, Pittsburgh. It is expected to boost the plant's capacity for wide flange beams . . . Operation of induction heating equipment, supplied by **Induction Heating Corp.**, Brooklyn, N. Y., was demonstrated to capacity crowds at the U. S. Small Business Industries exhibit (see photo) in Bombay, India recently . . .

Thirty-four plants of **Air Reduction Co., Inc.**, New York City, have been awarded certificates for safety achievement in 1959 by the **Manufacturing Chemists' Assn., Inc.**, Washington, D. C., for completing a calendar year without a lost-time accident . . . **Shieldalloy Corp.**, Newfield, N. J., has opened a new sales office in Pittsburgh . . .

Graver Tank & Mfg. Co., East Chicago, Ind., has been awarded an $8,094,200 contract to build surge tanks, penstocks and risers for the hydroelectric power plant at Oahe Dam, in South Dakota, largest rolled earth dam in the world. The contract, which will be shared by **Western-Knapp Engineering Co.**, San Francisco, was awarded by the **U. S. Army Corp of Engineers, Omaha District** . . .

For best results on all your grinding jobs...



get this complete guidebook

In this new catalog you get a lot more than just a listing of Norton weld grinding wheel types and sizes.

It brings you detailed information on the complete line of Norton wheels to do every grinding job better . . . describes the many different types of wheel construction . . . gives you facts about their performance, with on-the-job photos . . . lists applications for each different wheel . . . includes an up-to-the-minute net price supplement, covering all wheels.

All Norton resinoid wheels, incidentally, are now produced in the new 5-acre Norton Worcester Plant No. 8, on the most modern equipment ever developed. The Norton weld grinding favorites made here include the reinforced types — BD and BDA rigid and BFR semi-flexible — plus straight wheels, cut-off wheels, cups, cones and mounted wheels.

Find out which of these fast, tough wheels can benefit you most. Get your free copy of the new catalog from your Norton Distributor, or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

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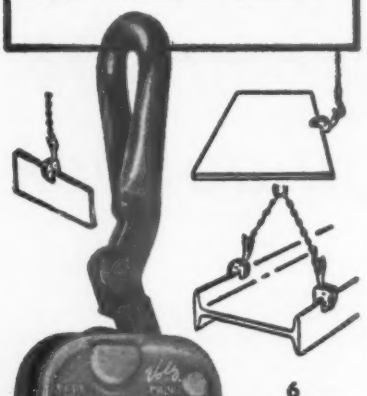
YOUR BEST MOVE . . . MOVE with **MERRILL** MATERIAL HANDLING DEVICES FOR THE MOST IN *Safety and Economy*

Imitated, but never duplicated, Merrill Lifting Clamps are Drop Forged to give you Safety in Handling and Economy in Operation.



6 SIZES

FEATURING THIS MONTH

ADJUSTA CLAMP
One clamp to take a wide range of grips. By simply pushing in or out on the adjustable jaw it will grab ¼" to 12" plates or blocks.

Over 25 Material Handling Devices described in our catalog C-2.

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Producers of Drop & Press Forgings
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About people . . .

Ralph H. Engstrom and *Robert E. Poethig* were elected vice presidents of Bastian-Blessing Co., Chicago. Engstrom, with the company since 1937, will remain as general sales manager; Poethig, who has served since 1939, retains his duties as director of engineering and research.

Engstrom

Poethig

Recent personnel changes at Vickers, Inc., Detroit, have seen *Gordon H. Clayton* and *Merrill A. Hayden* elected as vice presidents. Clayton, general manager of the Electric Products division, has been with Vickers since 1958; Hayden is general manager of the Machinery Hydraulics division. *E. L. Asch* has been appointed director of sales training.

Robert Friedly has been appointed general sales manager for products by Gregory Industries, Inc., Lorain, Ohio. Other appointments include *Paul H. Butterfield*, product manager for construction; *George T. Kramer*, product manager for industrial sales; and *Alex M. Oleair*, product manager for steel mills and transportation industries.

After five years as manager of the firm's Houston, Texas, isotope laboratory, *Leonard F. Tischler* has been named assistant manager of contract sales by Tracerlab-Keleket Corp., Waltham, Mass. He will now be responsible for the procurement and administration of all special contract business for the western division at Richmond, Calif.

T. C. DuMond has been appointed as manager of the National and Regional Metal Congresses by the American Society for Metals. In addition, he will serve as director of membership and chapter relations, in which position he will be responsible for liaison, counsel and direction from ASM headquarters to the Society's 31,500 members throughout the U. S. and Canada.

Henry S. Wingate has been elected chairman of the board and chief officer of International Nickel Co., Inc., New York City. *J. Roy Gorden* was elected president, and *Ralph D. Parker*, senior vice-president. Other elections included *John A. Marsh*, as president of the Huntington Alloy Products division; and *G. K. Crosby*, *J. M. Weldon* and *J. E. Carter* assistant vice presidents of the division.

Wayne Rising, vice-president, Ducommun Metals & Supply Co., has been elected president of the Steel Service Center Institute, Cleveland. Announcement of his selection came at the organization's 51st annual meeting at Miami Beach.

C. B. Herrick Mfg. Corp., Cleveland, has appointed *Orla Madsen* chief engineer. He has been serving as the firm's electrical engineer for the past five years.

Madsen

Oyler

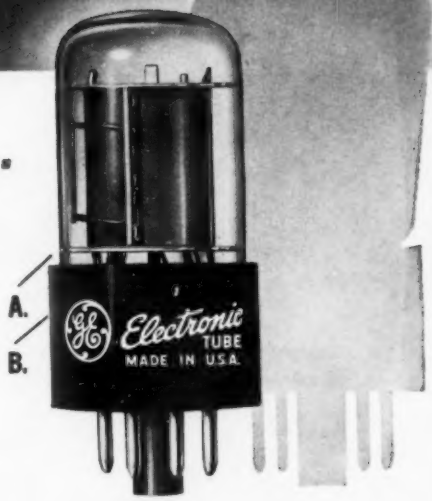
Dr. Glenn W. Oyler was recently named head of the welding research and development department at M & C Nuclear, Inc., a subsidiary of Texas Instruments Inc., Attleboro, Mass. He will be responsible for the conception and development of new methods and techniques for assembling nuclear fuel elements and allied components by welding.

Charles M. Beeghly has been elected president of Jones & Laughlin Steel Corp., Pittsburgh. He moved up from executive vice president.

Lincoln D. Hall has been named manager of a newly created midwest district by Tube Turns Div., Chemetron Corp., Chicago. He will be in charge of sales in a 10-state territory, and will operate from headquarters in Kansas City, Mo.

You can't beat it for performance....
You can't equal it for ruggedness....

NEW G-E 2050-A THYRATRON



Why install a welding-control tube with outmoded design (16 years old), when you can have a thyratron as new as up-to-the-minute engineering can make it? General Electric's 2050-A gives you, in its trim, compact envelope, greater tube strength and improved reliability... *at no price increase.*

Socket-wise, the new tube is fully interchangeable with Type 2050. Electrical characteristics are the same. To assure high welder output in your plant, take this no-extra-cost step ...ask your General Electric tube distributor to deliver new 2050-A's on all your replacement orders, starting immediately! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

30% SHORTER THAN 2050 (RIGHT)... FAR STURDIER!

Also 18% less diameter. Greater compactness adds strength to withstand vibration. The new 2050-A is your tube for tough welding-control service!

A. DOUBLE BRACING OF TUBE STRUCTURE! See how the 2050-A bottom mica fits snugly against the glass envelope—unlike the 2050 mica, which "floats". Tube cage is held firmly in place.

B. MODERN BUTTON-STEM BASE! Clean, compact base design means short leads that are all internal, requiring no "spaghetti" insulation as found in the old-style long-lead 2050.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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flaw hunter

with this in hand

you find cracks and hidden surface flaws

in √ **metals**
in √ **plastics**
in √ **ceramics**
in √ **glass**
in √ ***minutes***

Use PIXchek penetrant dye system for inspection after any metal-working process—casting, forging, welding, grinding, extruding, drawing, shearing—the gamut of operations. PIXchek is equally adaptable to single part or quantity-run inspection.

Everything you need is in this handy flaw-hunting kit

Sturdy steel hinged case with aerosol spray cans of PIXchek Dye, Cleaner, and Developer, plus extra cans of Dye and Cleaner for brush and wipe-on applications. The coupon below can start you flaw hunting right away.

$ only **35**

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Please ship ☐ PIXchek Kits @ $35.00

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Kenneth G. Kieker has been appointed assistant to the midwestern regional manager for National Cylinder Gas Div., Chemetron Corp.

McNeill

Mooney

S. W. McNeill has been named a factory representative for National Welding Equipment Co., San Francisco. He will represent the firm in southern California and Nevada, Arizona, and New Mexico.

F. J. Mooney, convention manager for the American Welding Society, has been named chairman of the New York Group of the National Association of Exhibit Managers.

Three new members were elected to the board of directors of Air Reduction Co., Inc., New York City. They are *John T. Dorrance, Jr.,* assistant to the president and a director of Campbell Soup Co.; *Dr. Richard G. Folsom,* president of Rensselaer Polytechnic Institute; and *August J. Thoma,* vice-president of Air Reduction Sales Co.

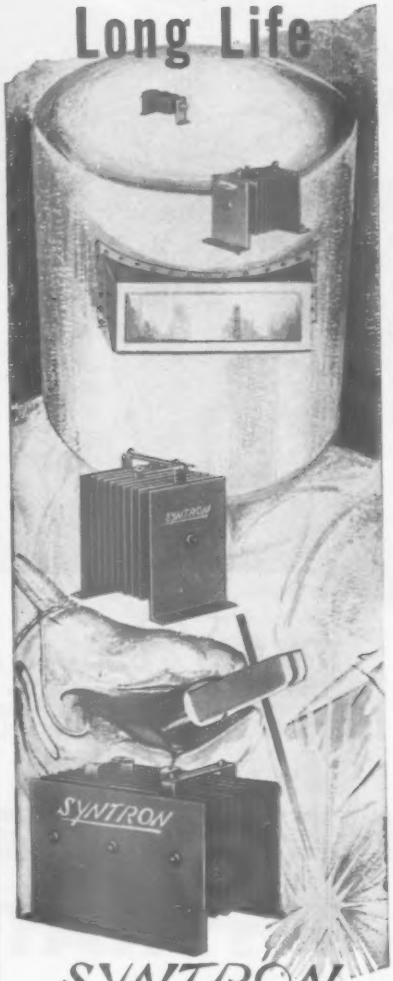
Harold P. Caine has been named regional manager for Eutectic Welding Alloys Corp., Flushing, N. Y., in its southern region. He will have headquarters in Atlanta.

Kenneth A. DeLonge has been appointed manager, direct sales, in the primary nickel department of International Nickel Co., Inc., New York City. With the company since 1937, DeLonge was until now sales manager for the Pittsburgh region.

Recently appointed assistant editor of Metal Progress, monthly metals engineering publication of the American Society for Metals, is *Fred L. Siegrist.* He was formerly training supervisor for ASM's home study school division of the Metals Engineering institute.

Edward S. Fraser has been elected vice president of manufacturing by directors of Chicago Bridge & Iron Co., Chicago. With the firm since 1939, Fraser has been in charge of manufacturing operations for the past six months.

Performance and Long Life



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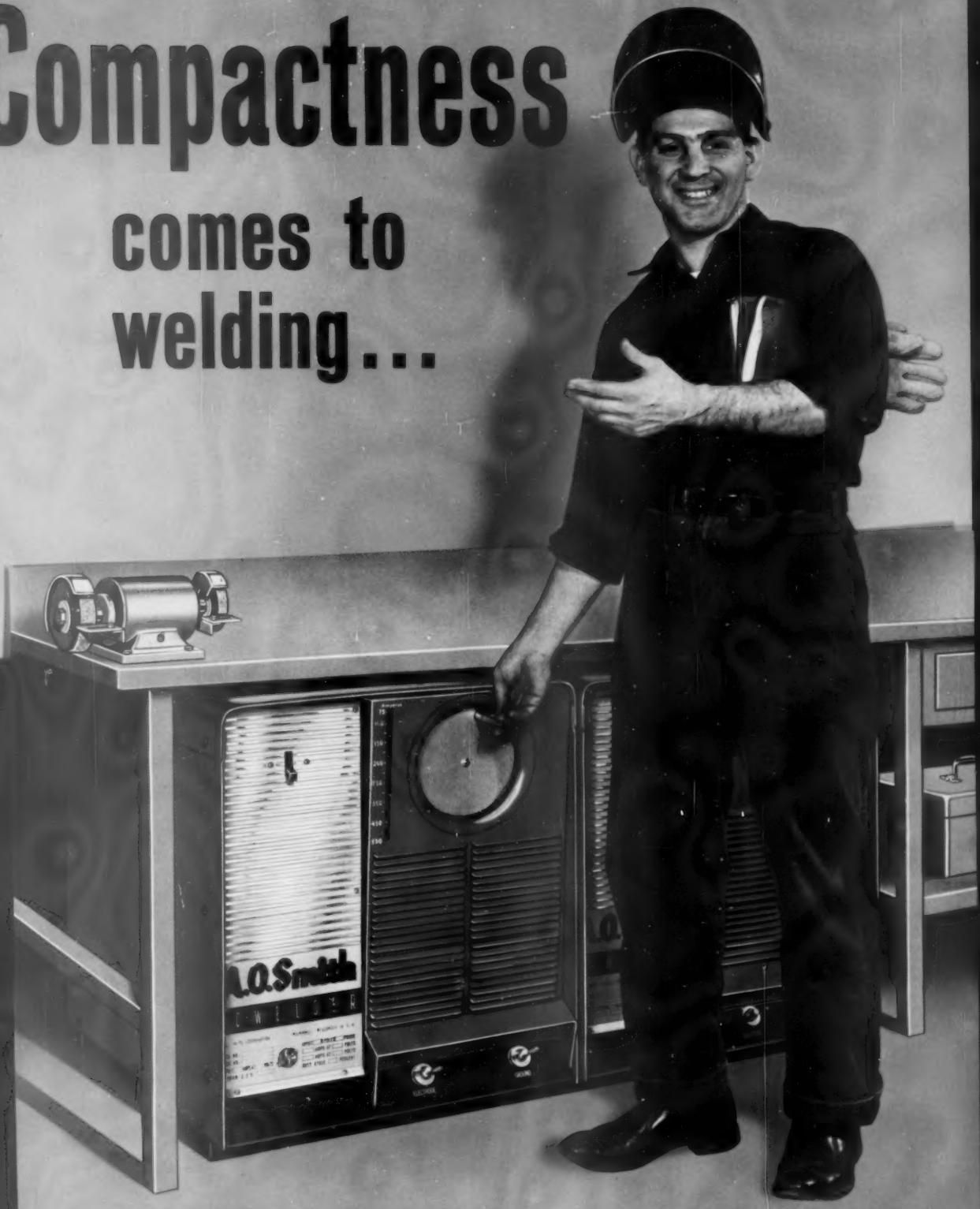
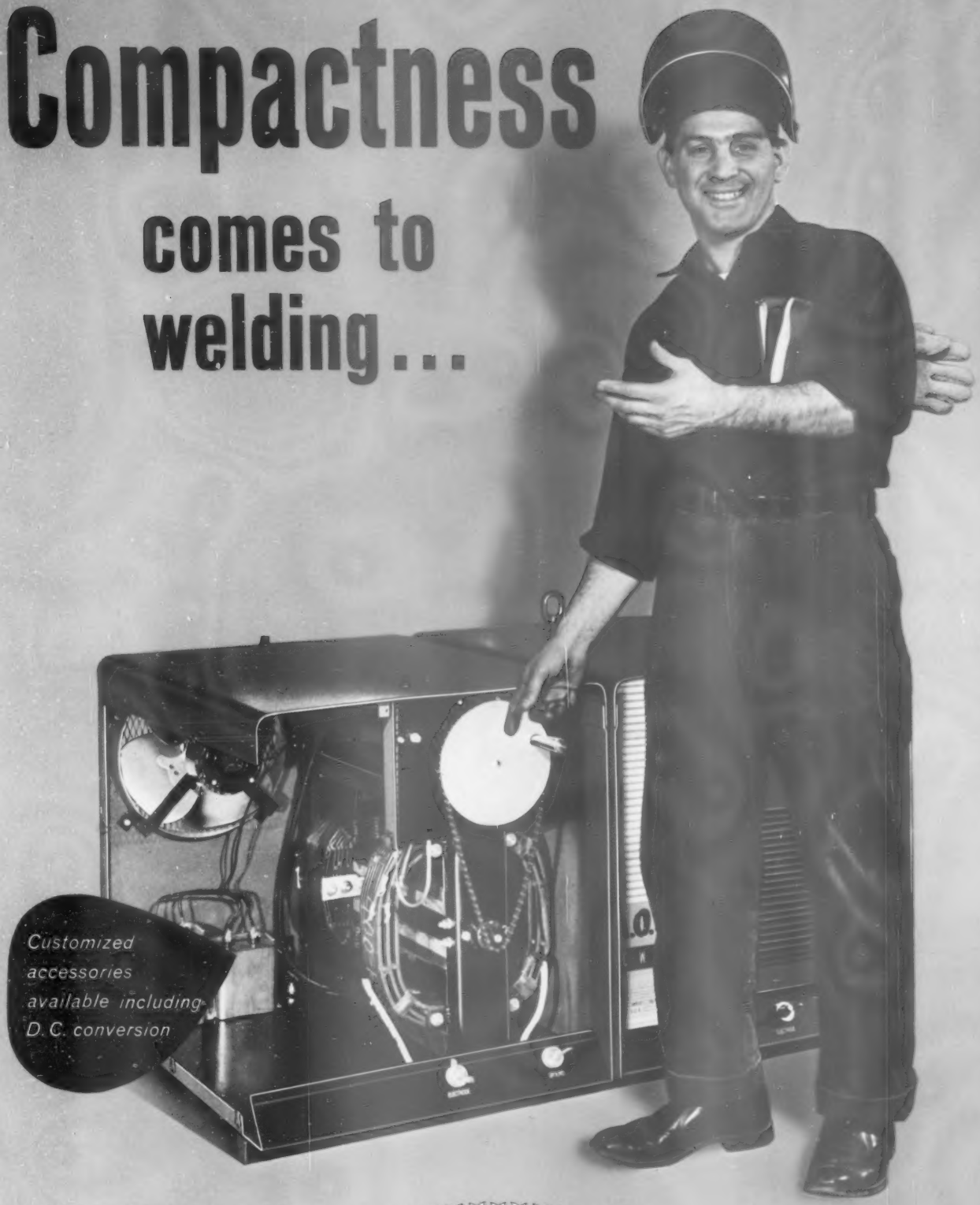
Compactness comes to welding...



A. O. Smith's new MONARC line compacks more machine in a smaller package at a smaller price

400 AMP model shown—all models same size.

Compactness comes to welding...



Customized accessories available including D.C. conversion

A. O. Smith's new MONARC line

trims the waste from welding machines

No waste of space!

It stacks! It racks! It slides under a bench with the greatest of ease. Only 28 inches low . . . 24 inches wide . . . 30 inches deep—the **MonArc** fits where others take up valuable floor space. You release area for increased production — an important factor with industrial space cost averaging $10 a square foot. We achieved this compact design without compromising superior welding characteristics of the moving-coil machine by making coil movement lateral.

No waste of motion!

We made time and motion studies. We learned how to achieve compactness with no sacrifice in operational ease. For example, while the **MonArc** is a *foot lower* than conventional machines, the full-range, stepless current-control wheel is at convenient arm's length—higher than competitive models. We also cut down handwheel turns to 15 — fewer turns and easier turning than with any other standard characteristic welder in the market.

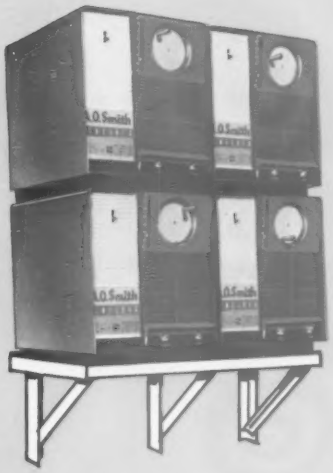
No waste of money!

Superior in design. At an economical price, no other machine gives you so much for your money. But while you get more, you never get more than you want. The **MonArc** line consists of three basic machines (300, 400, 500 amp models). We customize this basic line with a selection of tailored accessories. You check off exactly what you need — no built-in "excessories" that add only cost to your operation.

No waste of time!

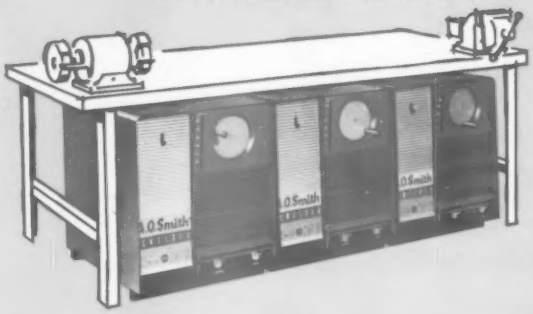
Our customized approach also saves on delivery time. You don't have to wait two or three weeks for delivery of a certain model from our home factory. Basic machines and customized accessories are stocked in warehouse centers and distributor houses enabling us to meet your requirements exactly . . . and meet them quickly.

It stacks up to three high!



It racks!

It slides under a bench!



SEE HOW IT STACKS UP! The new MonArc line is on display at A. O. Smith welding equipment distributors everywhere.

SPECIFICATIONS

Series No.	Rated amperes at 40 volts	Input kw	Duty cycle	Primary amperes with PF correction		Primary amperes without PF correction		Power Factor*		Open-circuit volts	Welding range	Weight in pounds	Height	Width	Length
				230 volts	460 volts	230 volts	460 volts	without capacitor	with capacitor						
300 L	300	12	60%	100	50	108	54	65.4%	79%	80	60-430	363	28″	24″	30″
400 L	400	16	60%	124	62	140	70	65%	84.5%	80	75-550	400	28″	24″	30″
500 L	500	20	60%	158	79	174	87	66.7%	84.2%	80	90-670	415	28″	24″	30″

*Power factor is the average value which includes the benefits of the power factor capacitors when not welding (based on 60% duty cycle).

Because welding fabrication is our full-time business, A. O. Smith maintains the industry's most comprehensive research and development facilities. That's why we can offer you America's finest machines, accessories and electrodes. And when you call your man from A. O. Smith, you'll find that he's more than just a salesman. He's a welding specialist fully qualified to help with your welding problems.

Through research ... a better way

A.O.Smith
CORPORATION
WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin
A. O. Smith INTERNATIONAL S.A., Milwaukee 1, Wis., U.S.A.

MW-263

LITHO IN U.S.A.

Appointed general sales manager of the newly consolidated six divisions of Progressive Welder and Machine Co., Pontiac, Mich., is *William B. Payne*. With Progressive since 1948, Payne will head marketing of the company's resistance welding equipment.

Payne

Solarz

Rankin Mfg. Co., Alhambra, Calif. has appointed two district sales managers: *Ted Braucht* will handle the firm's southern district, which takes in Texas, Oklahoma, Arkansas, Louisiana, and Alabama; and *William Solarz* will take charge of the northeastern district, comprising eastern Canada, the New England states, New York, Michigan, and Ohio.

Election of *Robert A. Hall* as a director has been announced by Missile Systems Corp., Los Angeles. Hall is vice president and general counsel of Bennett, Osborn & Hall, financial and management consultants.

Elected vice president and general manager of the electronics and instrumentation division of Baldwin-Lima-Hamilton Corp., Philadephia, is *Robert O. Bullard*. He was formerly general manager of the Power Tube Department of General Electric Co., Schenectady, N. Y.

Alan Wood Steel Co., Conshohocken, Pa., has named *Robert E. Bergey* sales representative for foundry coke and pig iron. Employed by the company since 1937, Bergey will call on customers in cities north of Philadelphia.

Warren J. Trifiro has been named a sales representative by LaSalle Steel Co., manufacturer of cold finished steel bars. He will represent the company in the southeastern territory.

A. J. Zaccardi, assistant controller of Air Reduction Co., Inc., New York City, has been elected controller of that firm.

Joseph J. Murphy has been named district representative for the middle Atlantic states by Hobart Bros. Co., Troy, Ohio. He will work throughout Pennsylvania, New Jersey, Delaware, Maryland, Washington, D. C., and Virginia.

A. Ray Dow has been appointed general sales manager of British Oxygen Canada, Ltd., Toronto.

Died . . .

Albert Whitelaw, retired executive of the Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J., died April 24 at his home. Mr. Whitelaw, a 38-year employee of Manhattan, joined the company in 1922 and helped perfect the first successful hydraulic brake piston cup.

C. J. Hogan, 33, district sales manager for Miller Electric Mfg. Co., Appleton, Wis., died at his home in West Covina, Calif., on May 16. Mr. Hogan, who joined Miller in 1953, had also worked for National Cylinder Gas Div. and Union Carbide Corp.

S. A. Blagden, chairman of the board, Federal Machine and Welder Co., Warren, Ohio, died at his home in Tennessee on May 10.

Robvon's Commercial Backing Rings are designed for quick easy alignment of pipe or tubing and assure precise close tolerance fit-up. Robvon Backing Rings allow complete penetration and fusion of the weld. Robvon Backing Rings radiograph perfect certified welds. The patented nubs automatically set the welding gap for the root-pass. The internal bevel and flat inner land assures non-restricted fluid flow.
ROBVON BACKING RINGS APPROVED FOR WELDING PIPE, VALVES AND FITTING JOINTS
ROBVON BACKING RING COMPANY
675 Garden Street
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ELizabeth 2-9613
ROBVON also manufactures machined rings to specification. Write for full information.
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"Yes, the De Witt System of Joint Preparation is Worth Investigating"

said **13** prominent pipe manufacturers and welding experts who saw it demonstrated

More than 20 years of preparation were required to develop the De Witt System of Joint Preparation. Revolutionary in concept and application, it prepares joints in ANY metal with a minimum of work and expense.

Those who have seen the system in operation are amazed at the ease and speed with which you can switch pipes, thickness of walls or angle of intersection without the use of dies or expensive milling equipment.

The De Witt System uses carbide tooth saws or Wallace safety type abrasive wheels and is the outgrowth of Wallace "Cut-Machining", the low cost process used throughout the metal working industry.

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Reprints from WE

Reprints of certain articles published in Welding Engineer are still available. A list of these appears below. Reprints may be obtained for 15 cents each, except where otherwise noted. Payment must accompany all orders. For quantity orders, write for special prices. Order by title from: Reprint Editor, Welding Engineer Publications, Inc., Box 28, Morton Grove, Ill.

Techniques for torch brazing aluminum

Procedures and techniques for brazing aluminum, are detailed. Includes data sheet on brazability of aluminum alloys plus four tables listing commercial products and their characteristics. This reprint is free.

Design for welding

Basic knowledge required when designing, or redesigning for welded construction is detailed and discussed. Sixteen page reprint includes 11 data sheets.

The meaning of weldability

Weldability of carbon steels and alloy steels, as well as some other metals, is discussed. Sixteen page reprint includes three data sheets.

Tungsten inert gas

A 16 page report on the history, theory and application of the Tig welding process. Includes data sheet on proper current selection. This reprint is free.

Welding of dissimilar metals

Complete details on welding dissimilar metals using NiCrFe electrodes and wires. Eight page reprint includes charts on properties, test results and data sheet on properties of other metals.

Acetylene

A 12 page salute to the IAA and acetylene, details the great success of this gas. Includes a history of the IAA and "The Acetylene Journal."

Fixtures for brazing

Presents requirements for designing brazing fixtures and materials to be used. Data sheet on properties of non-metallic fixture materials included. This reprint is free.

Selection, welding of CrMo alloy steel pipe

Discusses determining factors in selection of chromium-molybdenum alloy steels and evaluates the effects of pre- and postheat treatment on weld properties.

How to select proper regulators

Performance characteristics of equipment controlling gas flows during welding, cutting and other operations are given, as well as selection rules.

Filler metals for joining

Brazing filler metals are detailed and each group is analyzed. Includes data sheet on how to select silver brazing alloys.

Production welding controls

Discusses how material, labor and overhead effect total production welding costs, and how certain controls can result in greater time and dollar savings. This reprint is free.

New aluminum alloy not prone to brittle fracture

Extensive testing of 5083 aluminum alloy proves it has excellent weldability and weld ductility, and a good resistance to corrosion and stress corrosion. Testing for brittleness is detailed.

Explosive welding and forming open another door

A report on one of the newest entries into the welding industry, and how one pioneer company turned theories and practices into realities.

Our modern-day mythology

A rebuttal to some old-wives tales about the hazards of welding fumes, plus safety recommendations for situations where hazards might develop.

Understanding weld distortion and shrinkage

Causes of distortion and shrinkage can be determined if weld heat is understood. Eleven drawings are used to illustrate this welding problem.

Now one electrode, Inco-Weld "A", welds most dissimilar alloy joints...

many other problem joints as well

Now . . . with just one type of electrode . . . you can do 90% of your tough welding jobs.

This versatile electrode is Inco-Weld "A"* — with the distinctive green flux coating.

Inco-Weld "A" electrode produces X-ray quality welds between most dissimilar alloys . . . 30 known combinations to date. It also produces satisfactory "impossible" joints . . . welds, for example, in equipment too big for preheat.

These welds are strong, sound and corrosion-resistant, suitable for severe service and pressure conditions.

Read where and how Inco-Weld "A" electrode is being successfully used. See examples of the work in the new Inco-Weld "A" folder. They will open your eyes to important savings. For your copy, just write Inco.

*Registered trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17, West Virginia

INCO-WELD "A" electrode is supplied in 14-inch lengths in four diameters, 3/32-, 1/8-, 5/32-, and 3/16-inch...packed in 5-lb containers.

INCO WELDING PRODUCTS
electrodes • wires • fluxes

New products

. . . use card on page 83

A-c arc welders

Line of a-c 180-amp arc welding outfits are designed for medium-duty applications. Automatic, built-in volt-arc characteristics provide deep penetration at high ampere settings, and soft arc at lower settings, for light-gage metals, according to company. Electrode capacity is 1/16 though 3/16-in. diameter. Units are designed for operation from 230-volt a-c source, and provide from 15 to 180 amps welding current. *Metal & Thermit Corp.*

Circle No. 1

Butt welder

In continuous tube mill, flat skelp to maximum size of 0.337-in. x 20-in. wide is joined—one coil to the next—for high production on butt welder and trimmer. Strip is flash-butt welded and the flash trimmed off in a rapid, automatic cycle. Before clamping the strip for welding, the ends are run against a gage or space bar, which is inserted between the welding dies to assure that the proper amount of strip projects from the dies for welding. *Taylor-Winfield Corp.*

Circle No. 2

Exhauster unit

Compact exhauster unit rolls to the work, cleans air of gases, fumes, smoke and heat. Tubing and receptor intake are attached as easily as vacuum cleaner attachments. Exhaust unit is mounted on rubber-wheeled truck which stands on end in a 25-in. x 31-in. area. Shipping weight 130 lb. *Car-mon Products, Inc.*

Circle No. 3

Power rectifiers

Silicon power rectifier series composed on styles ES-21 and ET-31 have peak forward voltages of 1.5 volts maximum at 25 amps. Peak inverse current is 5 milli-amps at 100 C and a thermal drop of 2.75 C/watt maximum. Mounting torque for ES-21 is 50 in.-lb maximum and for ET-21 it is 300 in.-lb maximum. Overall length is 1 5/16-in. for ES-21 and 1 1/16-in. maximum. *Syntron Co.*

Circle No. 4

Riegel

. . . the preferred glove among skilled welders

TOPS IN DOLLAR VALUE

CHOSEN BY SKILLED WELDERS for extra heat protection, greater finger dexterity, and all-around comfort. Horsehide and "Flextan" leathers stay soft after dry-cleaning. Exposed seams completely welted. Seamless backs.

CHOSEN BY EXPERIENCED BUYERS for soft, sure comfort, longer wearability, excellent price, and quick acceptance in the plant...backed by Riegel's ready service and quick delivery.

COMPLETE LINE for any welding need. Let Riegel's specialists help match the right glove to the job. Ask for free catalog.

GENUINE HORSEHIDE PALM No. 956
Horsehide Palm, clute pattern cut extra long to prevent wrist chafing, and fourchetted for extra comfort and dexterity. Welted and wool-lined for complete protection.

HEAVY WELDER No. 997
Top quality green "Flextan", lined for heavy, hot jobs.

WELDERS MITTEN No. 987
Green "Flextan" leather, excellent protection, flexibility of finger movement.

SPOT WELDER No. 897
For lighter jobs, unlined green "Flextan" leather.

RIEGEL TEXTILE CORPORATION • Conover, N. C.

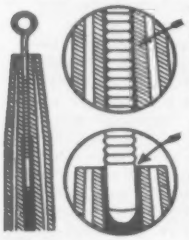
World's Finest CUTTING and WELDING TIP CLEANERS

WYPO
WIPES AND POLISHES

YOU GET SO MUCH MORE IN WYPO
Made of Stainless Steel

DOUBLES THE LIFE OF YOUR WELDING AND CUTTING TIPS

The exclusive circle design found only in Wypo Cutting and Welding Tip Cleaners provides as many as 60 more cleaning edges per inch of cleaner.



These rounded outer edges of cleaning ridges clean and polish tip orifice without scratching or cutting.

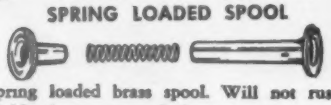
This smooth pilot guides WYPO Tip Cleaner into tip Will not enlarge or damage tip port.

This cross section view of WYPO Cleaning Surfaces shows these exclusive features:

Rounded cleaning surfaces that won't jam or cut.

Straight sided valleys insure thoro cleaning by removing all waste.

SPRING LOADED SPOOL

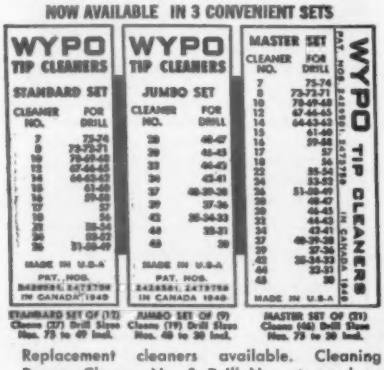


Spring loaded brass spool. Will not rust. Holds cleaners securely in case.

DOUBLE WOUND EYES

Insures longer life for small sizes of WYPO Tip Cleaners. Will not pull out of case.

NOW AVAILABLE IN 3 CONVENIENT SETS



STANDARD SET OF (12) Cleans (27) Drill Sizes Nos. 75 to 49 Incl.

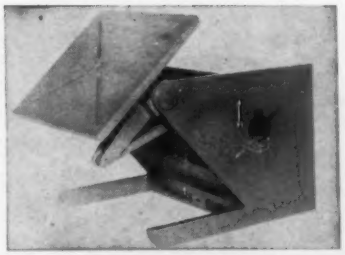
JUMBO SET OF (9) Cleans (19) Drill Sizes Nos. 48 to 30 Incl.

MASTER SET OF (21) Cleans (46) Drill Sizes Nos. 75 to 30 Incl.

Replacement cleaners available. Cleaning Range—Cleaner No. & Drill Nos. stamped on back of each case. WYPO GIVES YOU MORE!

SOLD BY LEADING WELDING SUPPLY DEALERS

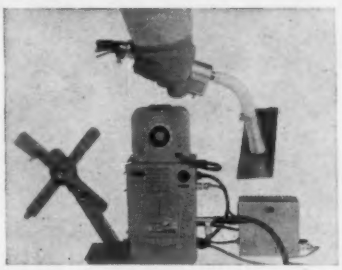
MAITLEN AND BENSON, INC.
1195 Ostrick St., Long Beach 4, Calif.



Work positioner

Toggle tilt work positioner rotates and tilts turn-table electrically to permit downhand welding. Turntable is T-slotted diagonally to allow work to be clamped easily and securely in place. Unit features a unique toggle lever and segmented drive gear design tilts table and delivers maximum thrust with minimum horsepower, according to manufacturer. Available in capacities ranging from 2,500 to 25,000 lb with table heights from 34½-in. to 95-in., positioners may be ordered with non-electric (20-to-1 ratio), electronic (100-to-1) or precision (full rpm with two cycles) variable speed controls. *World Electric Co.*

Circle No. 5



Mig spot welder

Mild steel, galvanized carbon steel, stainless, aluminum, and other metals 0.030 in. to ¾-in. can be spot welded from one side with new metal-inert gas spot welder. Unit can also be used to plug weld metals ¾-in. thick and greater. Space, tack, and bead welding can also be accomplished. Equipment is capable of producing more than 20 spots per minute using carbon dioxide, argon, helium, and other shielding mixtures depending upon application. *Hobart Bros. Co.*

Circle No. 6

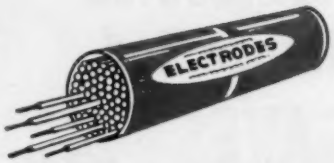
Automated welder

Four-station in-line transfer automated welding machine is designed so that each welding station is fired in sequence and only half the guns in each station are fired at one time to permit the machine's use in plants having average electric power. Unit performs 55 direct welds in assembly of a reinforcement plate to an automobile rear suspension crossmember at a production rate of 165 parts per hour at 80% efficiency. Welder occupies floor space of approximately 14 ft x 25 ft and is 13 ft high. Current is supplied by 100 kva transformers. *Expert Machine Welding Co.*

Circle No. 7

if you need

this



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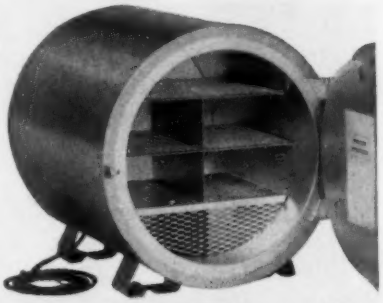

DryRod®

ELECTRODE OVEN

You need both for trouble-free Profitable Welding

The instant you unpack mineral coated electrodes, they start soaking up moisture. In *only 2 hours* they often soak up as much as 13 times allowable US Specifications. Moist rods cause porosity, under-bead cracking, rough welds, etc. Your rejects and rod scrap cut heavily into profits.

For consistently *good* welding, you *have* to keep rods *dry*. This oven does it . . . at pennies of cost.

Write for descriptive literature.

PHOENIX PRODUCTS COMPANY
4727 NORTH 27th STREET, MILWAUKEE 9, WIS.

Oxweld
TRADE-MARK

Flux-Coated Bronze Rod SAVES TIME!

THIS triple-purpose OXWELD bronze rod is ideal for braze-welding steel, cast iron, and malleable iron; for building up wearing surfaces; and for fusion-welding brass, bronze, and copper alloys.

Welds made with OXWELD No. 25M rod average 40% stronger and are more ductile than welds made with ordinary bronze rods under similar conditions. Pre-coated during manufacture, OXWELD No. 25M Flux-Coated Rod automatically introduces into the weld exactly the right amount of flux to insure both thorough cleansing and uninterrupted tinning action. This speeds your work by permitting you to give full attention to deposit of weld metal and control of the molten puddle.

OXWELD No. 25M Flux-Coated Bronze Rod is available in 1/4-, 3/16-, and 1/8-in. diameters from your nearby LINDE Distributor. For further information write LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Linde TRADE-MARK
UNION CARBIDE

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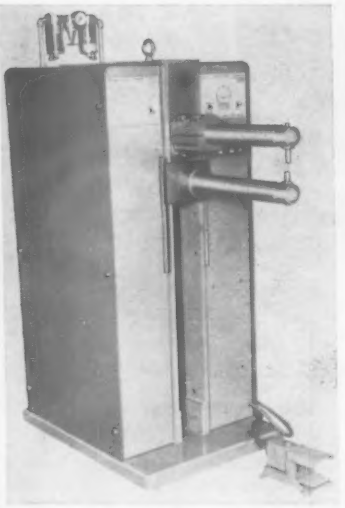
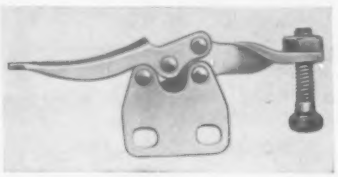


Spot welder

Spot welder converts to foot, air rocker or air press operation in the field quickly without drilling holes, welding or similar construction. Adjustable throat design enables user to move arms of welder in or out; lower arm may be raised or lowered. Heat control current adjustments may be made from 100% down to 20%; unit can be connected either to 220- or 440-volt source. Concealed water hose eliminates dangling, prevents breakage. "Slim-clearance" ejector holders allow slipping a tube or box over the horn for welding with an inside dimension as little as 3 in. Tapered tip adaptor is replaceable. All controls are accessible from the front and any part may be removed without disturbing other components. *Peer, Inc.*

Circle No. 8



Toggle clamp

Constructed with a solid one-piece forged base, large diameter bearings, heavy steel linkage and handle, medium-duty plunger-type toggle clamp has rated holding pressure of 1,600 lb. Height from bottom of base to top of handle is only 2 7/8 in; distance from bottom face of the base to the plunger centerline is 13/16 in. Overall length in forward locked position is 7 1/8 in. *Detroit Stamping Co.*

Circle No. 9

Correction

Our apologies to Singer Glove Mfg. Co., Chicago, for inadvertently ommiting the word "Glove" from its name in the New Product section last month. The error occurred on page 98 (item No. 25) under the item, "Lightweight Clothing."

CONTROLLED VISION

INSURES GREATER

Safety

thats why

THERMO-

FILTER PLATES

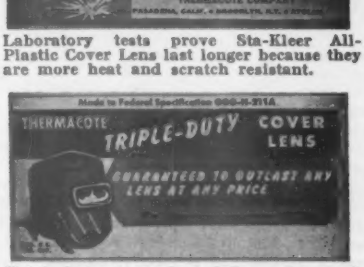
and

COVER LENS

are *FIRST CHOICE* EVERYWHERE

Thermo Filter Plates guaranteed to have less variation in density. Blue-green tint eliminates fatigue and eye-strain.

Laboratory tests prove Sta-Kleer All-Plastic Cover Lens last longer because they are more heat and scratch resistant.



Triple-Duty Glass Coated Cover Lens outsell all others on the market because they repel molten weld slag. Will not peel or discolor.

THERMACOTE
COMPANY
108 So. Delacey Ave. Pasadena Calif.

Portable X-ray

Lightweight, portable x-ray unit has a power range of 150 kv-3ma and can penetrate 1¾ in. steel. The Baltospot 150-D features new wide angle 60 deg tube which allows up to 50% greater linear exposure at any given distance. Port areas on both versions are end positioned for easy access to internal sections too small even to accept the entire head. Forward beam projection materially aids in this type of work. X-ray head measures 10-in. in diameter by 25-in. long and incorporates the X-ray tube, recently developed epoxy resin and lead oxide shielding, HT transformer, filament heating transformer, an automatic thermal cut-off device and receptacle for connection to the control. Total weight is 55 lb. Power supply is 115 or 230 volts, 50 or 60 cycles, single phase. *Balteau Electric Corp.*

Circle No. 10

Air hoist

Powered by rotary vane, explosion-proof air motor, and with complete protection against burn-out from overload, cable type air hoist meets all requirements for operation in hazardous atmosphere. Control valve automatically returns to neutral upon release of rope pendant. Upper safety limit also returns control valve to neutral. Standard lifts of 20 ft and 40 ft with variable speeds are offered in capacities from 1/4 ton to 2 tons. A three-reduction spur gear mechanism with large contact-area mechanical load brake is permanently lubricated and housed in a high strength aluminum alloy frame. *David Round & Son, Inc.*

Circle No. 11

Fiber discs

Better surface finishes are said by manufacturer to result from resin fiber disc's strengthened center hole. "Intra-oscillation" resulting from rapid center-hole breakdown when discs are forced onto out-of-round grinder spindles, is minimized. Discs are available in standard sizes ranging from 5- to 9¾-in. in diameter. Center mounting holes are standard ⅞- and ⅝-in. *Michigan Abrasive Co.*

Circle No. 12

Your

LINDE Distributor

has it—

1. Service

Every authorized LINDE Distributor is an independent *local* businessman who knows your welding and cutting needs, has them ready for you, and satisfies you promptly.

2. Know-How

LINDE Distributors are welding supply *specialists.* Their technical background, practical experience, and knowledge of local industry can help you with your welding and cutting problems.

3. Superior Products

Your LINDE Distributor carries a *complete* line of industrial gases, equipment and supplies for your welding and cutting requirements. He handles only high-quality products of proved efficiency and best suited to your individual needs.

A telephone call to your nearby LINDE Distributor will bring you the benefits of more than 50 years of LINDE COMPANY's pioneering and leadership in welding and cutting. If you don't know your local LINDE Distributor, look in your classified telephone directory. Or write for further information to LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Linde UNION CARBIDE

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GLAD YOU INVESTED YOUR MONEY THIS YEAR IN **COYNE ACETYLENE CYLINDERS.** COYNE "92" is the quality cylinder that gives you more for your money: appreciates more in value through the years: and is built for more years of service. Don't invest today without thinking of tomorrow.

Write or phone for the details.

COYNE *cylinder company*

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CARBIDE
They mean National Carbide's calcium carbide— Real potent... it's hot-crushed!
All you want— when you want it. In the RED DRUM. Wire for supplier...
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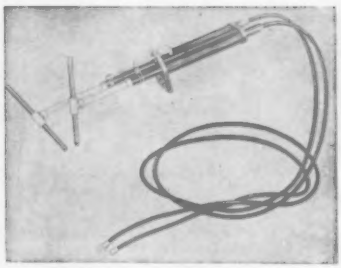


Arc torch

Versatile arc torch enables existing arc welding equipment to take on jobs formerly done only with gas. Creates intense heat electrically, and does not exert pressure which could displace molten metal or produce blow holes in thin gage metal. A-c model is available complete with two 10-ft cables, four 3/8-in. carbons, four ¼-in. carbons, and adaptors for ¼-in. carbons. Torch can be used for welding, brazing, general heating or preheating, soldering, and hardfacing. *Metal & Thermit Corp.*

Circle No. 13

Cutting torch

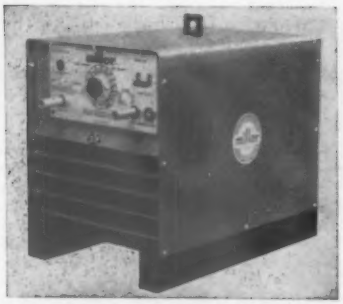
Lightweight top-lever cutting torch is ideal for one hand operation because the cutting lever is mounted forward and on top for better grip and balance, thus minimizing operator fatigue. Injector mixer completely mixes gases, resulting in fast starting preheat. There is no danger of backfire, says manufacturer, because gases are mixed in the head. Other features of unit are rigid triangle tube construction, silver-soldered joints, and "O" ring seals in the high pressure plunger chamber. Available in three different models: the 42 for acetylene, 42-F for propane, and the 42-N for low pressure natural gas cutting. Cutting capacity up to 8 in. with a wide range of tips obtainable for gouging, rivet washing, rivet cutting and thin plate cutting. *Harris Calorific Co.*

Circle No. 14

Testing units

Two magnetic particle testing units are said to provide economical detection of tiny flaws as deep as ⅛-in. below the surface. One unit is stationary, the other mobile. Stationary unit provides highly sensitive inspection for maintenance work in aircraft, automotive and railroad machine shops, as well as quality control and production runs of small parts. It detects flaws like inclusions, seams, critical weld defects and heat treat, grinding, forming and fatigue cracks. Mobile unit is used to find defects primarily on large rough parts such as forgings, rotor blades, drive shafts and other assembly items that must be checked on the spot. Stepless current control is variable for both magnetizing and de-magnetizing. *Picker X-ray Corp.*

Circle No. 15



D-c welder

D-c rectifier type welder is designed and built for indoor use. Features include horizontal design for stacking and space saving, heavy gage cabinet, sealed semi-metallic rectifier, lifetime cooling system, and electric control. Offered in two models, each with dual current ranges: Model H-3-SR, 40 to 295 and 75 to 450 amps; Model H-4-SR, 50 to 350 and 100 to 600 amps. *Miller Electric Mfg. Co., Inc.*

Circle No. 16

Safety glasses

New frame on safety glasses is made of acetate, features one-size saddle bridge for all three eye sizes, is available in two colors. Shallow-form permanent nose pads combine with eyewire stock in one continuous flare for maximum surface-to-face contact which distributes weight evenly. *Bausch & Lomb, Inc.*

Circle No. 17

Respirator cartridge

Respirator cartridge protects against the vapors of elemental mercury in air. Designed for use with firm's R-5000 series of interchangeable respirators, each cartridge includes a particulate filter for retention of airborne particles and a vapor absorbent bed for retention of metallic mercury vapors. According to manufacturer, cartridge offers protection against organic vapors as well. *American Optical Co.*

Circle No. 18

Disposable clothing

Tempora line of protective clothing is made of a scientific lamination of cloth and fiber, can be thrown away when used. Manufacturer claims items are soft and pliable, tear- and flame-resistant, cool and comfortable. Available in capes with sleeves, bib aprons and sleeves. *Singer Glove Mfg. Co.*

Circle No. 19

Ultrasonic iron

Eight-ounce 10-watt ultrasonic soldering iron, capable of soldering a wide range of materials without flux, is ideal for soldering semiconductor materials as well as metals such as aluminum, magnesium and their alloys, especially those characterized by rapid surface oxidation. Operating on normal 115-volt, 60-cycle power, the unit uses standard replaceable tips of various configurations. *Gulton Industries, Inc.*

Circle No. 20

Arc Spot Weld Gun

MODEL H. Patented

SPOT WELDS FROM ONE SIDE

- AUTOMATIC TIME CONTROL
- NO EXPERIENCE NEEDED TO WELD . . . SHEET METAL · AUTO BODY WORK · SIGNS · DUCTWORK · CABINETS · TANKS · PLUMBING · ROOFING
- COMPLETELY PORTABLE
- WELDS . . . MILD STEEL · GALVANIZED · STAINLESS
  Minimum 26 ga. — Maximum 14 ga. Welded to any thickness
- NEW WIDER RANGE POWER SUPPLY
- OPERATES ON 110/1/60 cy.

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CORPORATION
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"DURO is the coolest"*

*says Ben Ruff of Reed & Graham, Inc. "Before I had to change holders whenever the one I was using would get hot. Now, with DURO, I can weld a whole shift without the holder getting hot to my hand, even when using 5/16 in. hardfacing electrodes at high amperages."

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Proved by 28 years of welder's preference

- The Duro Electrode Holder has served the welding industry since 1932. It is famous for long life, positive grip and perfect balance. All parts are easily renewed. Semi- or fully insulated. Duro is available in 250, 300, 400, 500 and 600 amperes capacity.
- Cool operation — cool handling. Featuring "Long Jaw Design" for reaching those "hard to get at places."

THE DURO "STANDARD"

- Another feature is the square guard. It protects hands from heat and also prevents rolling and grounding when placed on a flat surface. There when you need it, is a hex key fitted into the brass core and held in place by the fiber handle for making fast cable connections.

DURO ENGINEERING COMPANY
31 OREGON AVE. · HAMDEN, CONN.

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WELDING ENGINEER
DOC! I'VE GOT A MILLION JOBS TO DO! JUST CAN'T GET TO THOSE RESISTANCE WELDING SPECIALS!
YOUR PROBLEM HAS A SIMPLE, PRACTICAL SOLUTION... CALL A TUFFALOY SPECIALIST!
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Call in the Tuffaloy expert. He'll give you practical, money-saving electrode designs. Write or call your local Airco or Tuffaloy office. Today.
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you name it—ALL-STATE has it

ALL-STATE makes quality fluxes for torch and soldering iron applications on all commercial metals . . . in the form you prefer: liquid, paste, powder, flux cored solders, flux coated rods. Working temperatures range from 300F to 2200F. Designed for maximum wetting action, minimum fuming. For instance:

DUZALL . . . a new liquid flux for all soft solders, all metals (except light metals). DUZALL eliminates pre-cleaning, increases capillary action, leaves minimum deposit. Comes in handy 4 oz. refillable dispenser-type plastic containers, and in larger units.

#11 BRAZALOY® . . . a paste or powder flux for use on 14 ferrous and bronze alloys. Wide temperature range: 1200F to 2200F. Non-corrosive, non-fuming. Also available extruded on Nickel Silver welding rods.

#31 BRAZALOY® . . . a highly active aluminum brazing flux that gives maximum wetting action, excellent capillary flow. Protects surfaces from discoloration, requires less after-cleaning. An outstanding temperature indicator.

S200 SILVER BRAZING FLUX . . . melts at 600F, becomes transparent at 1100F, protects heated base metal to 1800F. Induces excellent capillary action and flow of silver alloys.

Send for free copy of 54-page Instruction Manual and for information on custom coating your welding rods.

Distributor Stocked, convenient to buy. Economical to use.
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Safety switch

Vacuum safety switch features a miniature micro switch with contact points which have a positive snap action, enclosed to prevent arcing. Unit is wired in series with LP-gas solenoid valve as a safety measure to open the solenoid valve circuit, insuring positive fuel shut-off whenever the engine stops. Housing is aluminum die-cast with vacuum connection on side opposite terminals for accessibility to wiring. Switch is set to close between 1 in. and 1.5 in. of water column and is suitable for many different applications. *Beam Products Mfg. Co.*

Circle No. 21

Packaged outfits

Packaged welding and cutting outfits come in two styles: No. 1 features torch and cutting attachment with three welding tips and one cutting tip. Welding range, with included tips, is up to ⅜-in. steel; cutting range up to 3-in. sections. Outfit includes multi-seat regulators, goggles, wrench, instruction manual. Outfit No. 2 features torch and attachments capable of cutting up to 1¼-in. sections, and welding up to 5/16-in. steel. Additional tips can extend welding range up to 3/8-in. steel. *Modern Engineering Co.*

Circle No. 22

High voltage thyraton

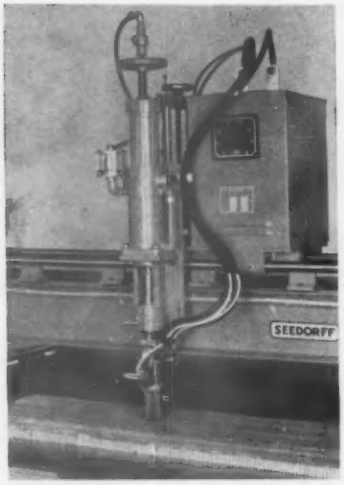
Inert-gas and mercury-vapor voltage thyraton was designed specifically for higher voltages encountered in the new spike welding applications. Ratings are: filament volts -2.5; filament current -9 amp; peak anode current -30 amp; average anode current -2.5 amp; condensed mercury temperature limits of -40 to +80 C. *National Electronics, Inc.*

Circle No. 23

Miniature grinding wheel

Line of miniature grinding wheels was developed for use in precision bearing manufacture. Tiny mounted wheels are so thin that the wall thickness is only the width of a few abrasive grains. Grinding ratios of volume stock removal as high as 100 to 1 have been obtained on 60 Rc hardened bearing steels. Typical specifications of these wheels are A320-TVM for bore grinding and A320-MVG, No. 22 treated, for ball race grinding. *Norton Co.*

Circle No. 24



Core splicer

Automatic core splicing machine for joining stainless steel honeycomb core sections by automatic spot and seam welding features two narrow copper alloy electrodes surrounded by eight cell-shaped probing fingers which automatically position the electrodes and line up the core sections. Welding head is actuated by an "airdraulic" cylinder for smooth uniform performance and is fully adjustable for splicing cores ranging from ⅛- to 3-in. depth. *A. P. Seedorf & Co.*
Circle No. 25

1-oz. clamp

Designed for holding small assemblies during multiple wiring, soldering and similar operations, "Tiny Toggle" clamp has holding pressure of up to 42 lb, weighs only 1 oz. Slotted mounting holes incorporated into new design simplify final adjustments. Bases are designed as standard flanged horizontal, vertical, double-strength horizontal on the right side only, and double-strength horizontal on the left side only. Each model of series is supplied with neoprene-tipped adjustment spindle for simple adaptation to work pieces. *Detroit Stamping Co.*
Circle No. 26

"Short leg" clamp

Two-ton structural clamp was designed with "short leg" feature in order to provide secure bite on even small junior size beams. Device eliminates lost time in slinging, attaching and releasing work in the process of moving, according to manufacturer. Completely drop-forged, the clamps are light in weight relative to their capacity. Grip range is 0-1-in.; clamps are 100% proof tested at 6 tons and have a safety factor of 5 to 1. *Merrill Bros. Inc.*
Circle No. 27

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AND BETTER WELDING SERVICE MEANS
MORE PROFIT FOR YOU!

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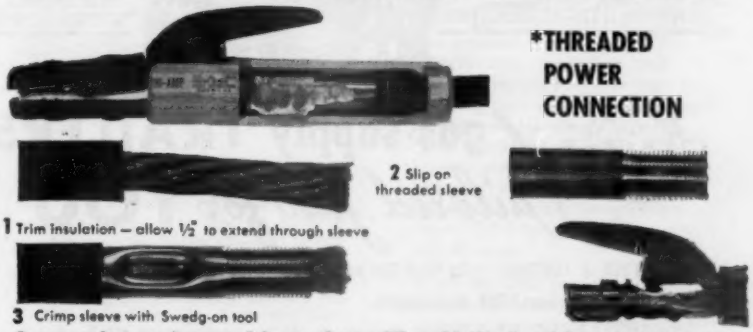
*THREADED POWER CONNECTION
2 Slip on threaded sleeve
1 Trim insulation — allow ½" to extend through sleeve
3 Crimp sleeve with Swedg-on tool

Screw sleeve into cable socket. (The ½" of cable strands will be forced against the holder tong member which gives another point of direct contact for good connection.)

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with the **FENWAY heavy duty NIBBLER**

MODEL EHN

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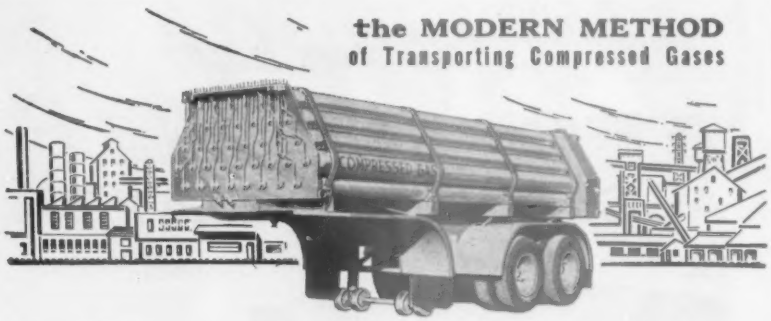

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O'FALLON 5, ILLINOIS

Universal torch

Lightweight cutting torch features built-in pressure control for smooth, even cutting with various types of fuel gases. Designed to eliminate flashbacks, the torch is equipped with injection-type mixing chamber and valve system which provide controlled, steady application of oxygen and prevent "jumps". According to manufacturer, unit cuts steel up to 15-in. thick or more when required, works equally well on low-pressure natural gas, propane and acetylene. Available with either 70 deg or 90 deg head. *Weldit Inc.*

Circle No. 28

Stainless wire

Stainless steel welding wire for use with submerged arc welding process is available for use with 308, 309, 310, 347 and 502 stainless, in 25-lb and 50-lb coils. Chemical composition of wire conforms rigidly to AWS and ASTM standards for corrosion resistance and chromium nickel steels. Each coil is thread-wound to facilitate unwinding, and a constant controlled tension is maintained during coiling to assure a neat coil. *Air Reduction Sales Co.*

Circle No. 29

Boring head

Boring head incorporates radical holder which provides a way to get precise boring within 50 millionths-in. Head is equipped with two calibrated dials — micrometer dial, used for quick adjustments, gives direct readings as the boring head is moved. Easy-to-read dial indicator is used for fine accuracy. Tool slide can be adjusted from zero to ¾-in. off center. Two models—one for 3/8-in. and one for ½-in. tool shanks — can be used in any vertical or horizontal boring and milling machine or any type of lathe. *Bokum Tool Co., Inc.*

Circle No. 30

Cutting torch

Natural gas cutting torch can slice through 30 in. of metal in a single pass, can be applied to special applications such as gouging, rivet piercing, and pad and fin washing. Bendable long length nozzles that can be used for riser cutting are also available. Torch weighs 3 lb, 14 oz, and is 27¼-in. long with 75-deg head angle. *Linde Co.*

Circle No. 31

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Seamless and stoutly reinforced with more comfortable and durable Fit-Rite, snap-on ratchet type headgear.

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NEW DESIGN ADVANTAGES

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MODELS K3 & M2

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SINCE 1910
INDUSTRIAL PRODUCTS DIVISION

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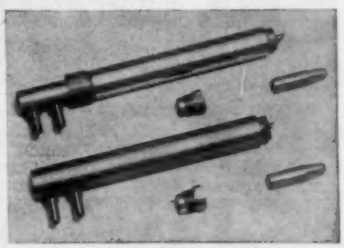
Circle No. 32

Engine generators

Line of engine generators are rated at 4,000 watts, will start and power a 3 hp motor under full rated load, or will safely carry a 4,000 watt load of lights on a single 115-volt or 230-volt circuit; or will carry many typical standby loads beyond the capacity of ordinary 3,500 watt or 4,000 watt generators, say manufacturers. Available in electric manual, or remote starting models; and with either carrying cradle or two-wheel dolly for easy carrying. *Wincharger Corp.*

Circle No. 33



Tip holders

Straight resistance tip holders are of two types: ejector and non-ejector. Both types use adapters to take the brunt of the wear (in the tip socket) and to permit interchangeability by simply changing adapters. Adapters come with four different tip sizes including the new No. 6 RW (⅜-in.) tip. *Air Reduction Sales Co.*

Circle No. 34

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Circle No. 35

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*Also Tempil° Pellets and Tempilaq° (liquid form)

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In 1936, MORT CLARK, then Vice-President of the world's largest sign manufacturer, wanted a welded galvanized sign frame. Every welder manufacturer said it couldn't be done . . . Mort Clark did it, received a check and certificate of achievement from the Lincoln Welding foundation—and

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Eliminates corrosion areas produced by welding, so that weld will stand up under paint, WITHOUT rust, as on ornamental iron. Simply use residual heat from welding, or reheat, wire brush, and apply. No fluxing—No fumes.

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75. POCKET GUIDE—Hobart Bros. Co. Booklet contains 78 pages of information on how to get better welds, including proper procedures, metal identification, common faults, and selecting electrodes.

76. VISOR GOGGLES – Jones & Co. Flysheet illustrates and describes firm's line of full-vision safety goggles.

77. INDUSTRIAL RADIOGRAPHY – Picker X-Ray Corp. New 12-page booklet describes equipment and methods of radiographing all kinds of industrial products.

78. A-C WELDERS–National Cylinder Gas Div., Chemetron Corp. Features, specifications, and optional equipment available with four SU series a-c welders are presented in two illustrated bulletins – NH-175 and NH-178.

79. WORK GLOVES–Advance Glove Mfg. Co. Twelve-page bulletin shows all styles and sizes of work gloves manufactured by firm.

80. WELDING MACHINES – Miller Electric Mfg. Co., Inc. Full line of firm's welding machines is illustrated and described in two-color booklet.

81. AUTOMATIC ARC-WELDERS – Taylor-Winfield Corp. Eight-page bulletin 8-513A describes 14 special, high-production, automatic, arc-welding machines with emphasis on production rates obtainable.

82. INSTRUCTION MANUAL – Arcair Co. Instruction manual describes operation and use of carbon arc welding process, with many applications illustrated.

83. BRAZING ALLOYS – American Brazing Alloys Corp. Analysis and comparisons of various low temperature brazing alloys are found in new 4-page folder.

84. CRYOGENIC SYSTEMS – Uniflex Mfg. & Engineering, Inc. Comprehensive brochure F contains information on advanced techniques in cryogenic systems, expansion joints, and plastic structures.

85. IRON-BASE ALLOY – Westinghouse Electric Corp. W-545 alloy vacuum melted high temperature alloy is subject of 12-page booklet, which covers metallurgical characteristics, mechanical properties, creep-rupture properties, and availability.

86. TIG WELDER – Taylor-Winfield Corp. Circular discusses how manufacturer's Tig unit automatically welds motor starter laminations for hermetically sealed motors used in refrigerator compressors.

87. ELECTRON BEAM GUN – High Vacuum Equipment Corp. Construction, theory, applications, cost advantages, and safety features of electron beam welder are set forth in bulletin.

88. GRINDING WHEELS–Norton Co. Catalog 1724 illustrates and lists specifications for many types of grinding wheels and cups, includes current price supplement.

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Morton Grove, Illinois

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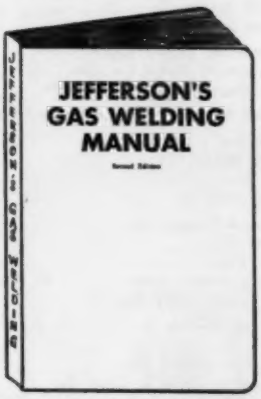

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150. Alloy Rods Co.—Detailed application information about "Atom-Arc" "T" in data sheet form is available.

151. All-State Welding Alloys Co., Inc.—Information on custom coating your welding rods and 54 page instruction manual available.

152. American Brass Co.—Publication B-13 gives you information on "Anaconda" welding rods and procedures for using them.

153. American Optical Co.—Further information available on AO's lightweight weldors' clothing.

154. American Platinum & Silver Div.—Booklet available, "A Complete Guide To Successful Silver Brazing."

155. Arcair Co.—Write for further data on Arcair "Copperclad" electrodes.

156. Atlas Welding Accessories, Inc.—Further information on the Atlas "Wide-Blade Tomahawks" and other weld cleaning tools.

157. Bausch & Lomb, Inc.—For more information on Ortho-Weld lenses circle No. 157 on Info-Aid card.

158. Bernard Welding Equipment Co.—Additional information available on Bernard's "Shortstub" electrode holders.

159. Black & Decker Mfg. Co.—Write for additional information on Black & Decker's Electric Hammer Line.

212. Bren Weld Corp.—Write for additional information on the Model H arc spot weld gun.

160. Bridgeport Brass Co.—Information on Bridgeport welding rods available in booklet, "Bronze Welding."

161. The Budd Co., Electronic Controls Div.—Additional data available on Monautronic V-2 welding control for resistance welding.

162. The Budd Co., Nuclear Systems Div.—Gamma Radiograph bulletin available.

163. Clements Mfg. Co.—Write for further information on the "Cadillac" blowtorch, for all kinds of heat treating and production processes.

164. Contour Sales Corp.—Further data available on "Curv-O-Mark" pipe layout tools for marking pipes and structural angle cuts of any type.

165. Coyne Cylinder Co.—Additional information available on Coyne acetylene cylinders.

166. Duro Engineering Co. — Write for further information on "Duro's" electrode holders.

167. Fenway Machine Co. — Complete specifications available on the Fenway heavy duty nibbler.

168. Flood Safety Products Co.—Write for further information on fiber glass helmets and other welding and safety equipment.

169. Galv-Weld Products—Information and distributor franchises on galvanized welding and samples are available.

170. General Electric Co., Electronic Components Div.—Further information on the new G-E "Thyratron" welding control tube, is available.

171. Glenn Pacific Power Supply Corp.—Further information on power supplies for welding processes is available.

172. Goldsmith Bros. Div. of National Lead Co.—Circle No. 172 for a free working sample of GB 88 Flux for silver brazing.

173. Harnischfeger Corp.—Bulletin W-158 showing 6 engine-driven models of P&H portable welders for field welding is available.

174. Harrisburg Steel Co. — Further information available on gas cylinders manufactured by Harrisburg.

175. Haynes Stellite Co.—Manual available, "Mechanized Hard-Facing," further explains Haynes hardfacing machines and alloys.

176. Hobart Brothers Co.—Complete information on the new "Tigpak" welder is available.

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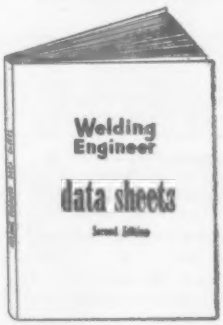

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177. Hobart Brothers Co.—Additional information on the 400 cycle induction heater also available.

178. Independent Engineering Co.— Write for further information on gas supply trailers manufactured by Independent for transporting compressed gases.

179. International Nickle Co.—Folder on Inco-weld "A" electrodes explains its uses, for welding most dissimilar alloy joints.

180. Jackson Products—Additional information available on the Jackson "Sealed Tight" electrode holder.

181. Lenco, Inc.—Booklet available, "Reducing Costs by Proper Care of Arc-Welding Circuits."

182. Lincoln Electric Co.—Additional data on Lincoln arc welding available and how you can cut costs.

183. Linde Co.—Write for further information on "Oxweld" No. 25M flux coated bronze rods.

184. Lukens Steel Co.—Lukens Plate-Mate Technical Catalog is available.

185. Maitlen and Benson Inc.—Information on "Wypo" cutting and welding tip cleaners.

211. Markal Co.—Literature and sample pellet of "Thermomelt" Temperature indicators available.

186. Merrill Brothers—Catalog C-2 further explains the "Adjusta Clamp" and other material handling devices.

187. Metal & Thermit Corp.—Write for additional information on M&T "Murex" electrodes, and an electrode selector.

188. Miller Electric Mfg. Co., Inc. — Complete information on the new AD-225-L gasoline engine-driven AC/DC welder/power plant.

189. National Carbide Co.—Write for more data on "more gas per pound" features of calcium carbide.

190. Norton Co.—Complete guide book for all your grinding jobs available, "Grinding Wheels for the Welding Trade."

191. Page Steel & Wire Div.—Folder containing information on submerged arc and inert gas welding wire and charts available; also name of your nearest Page distributor.

192. Phoenix Products Co.—Write for descriptive literature on "DryRod" electrode ovens manufactured by Phoenix.

193. Picker X-Ray Corp.—Further information on the "flaw hunting kit" for x-ray inspection.

194. J. M. Ragle Industries, Inc.—Write for more information on the Commando Round Soapstone Holder and other Commando products.

195. Rankin Mfg. Co.—Complete information on "Ranite" hardsurfacing rods and name of your nearest distributor.

196. Riegel Textile Corp.—Catalog on the complete line of welding gloves available.

197. Robvon Backing Ring Co.—Further information available on backing rings manufactured by Robvon.

198. A. O. Smith Corp.—Additional data available on the new A. O. Smith "MonArc" welding machine.

199. Stoody Co.—Hardfacing Guide Book gives techniques on equipment used in road building.

200. Stoody Co. — Write for booklet, "Stoody Alloys For Semi-Automatic Application."

201. Stoody Co.—Also available, "Stoody Alloys for Automatic Application."

202. Stoody Co.—Pocket size booklet on Stoody hardfacing alloys available.

203. Sylvania Electric Products, Inc. — Further information available on Tungsten electrodes manufactured by Sylvania for "TIG" welding.

204. Syntron Rectifier Div. —Information and specifications available on Syatron Selenium welding stacks.

205. Tempil Corp.—Sample Tempil pellets available and information on Tempilsticks.

206. Thermacote Co.—Data available on Thermo Filter plates and cover lenses.

207. John Tillman & Co.—Write for additional information on Tillman gloves for weldors.

208. Tuffaloy Dept.—Information on resistance welding electrode designs available.

209. Victor Equipment Co.—Further information on Victor cutting tips available.

210. Wallace Supplies Mfg. Co.—Booklet available, "The De Witt System of Joint Preparation."

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Solving the difficult problem of joining light metals for outer space vehicles is just one of many new uses for TIG welding. And for this kind of critical application, no finer Tungsten Electrode is made than by Sylvania.

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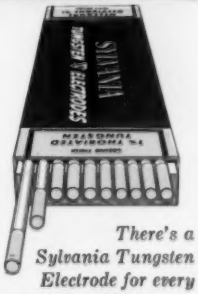

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Give worn equipment a new lease on life by surfacing with Anaconda Welding Rod

Anaconda Welding Rods are widely used in production and maintenance operations in the manufacture of all types of mechanical equipment and consumer goods. Familiar uses are the joining of iron and steel parts by oxyacetylene braze welding and the oxyacetylene braze-welding repair of broken machine parts. Of equal importance is their value in overlaying iron and steel to reduce the friction of sliding surfaces, and in rebuilding worn surfaces to get continued usage from parts that would otherwise be scrapped. Anaconda-997 (Low Fuming) Bronze, Tobin-Bronze 481, and Nickel Silver-828 Welding Rods are useful for many such applications.

Oxyacetylene braze welding is employed for these surfacing and rebuilding operations because of its speed, efficiency, and the convenience of using the equipment and skills available in most job shops. The many advantages, which result from the low temperatures of application, include:

1. ***Procedures which are virtually foolproof.*** The molten bronze automatically tins out and fuses to the base metal when the latter reaches the proper temperature. The rate of heat input is low enough to permit excellent control of the weld metal, and deposits are easily built up even in the vertical position.
2. ***Low residual stresses.*** The overall heating that accompanies the process reduces temperature gradients and minimizes distortion.
3. ***Economy in time*** . . . frequently repair welds are made without dismantling equipment.
4. There is ***no embrittlement of*** cast iron due to high temperatures. Machinability is retained and cracking tendencies are eliminated.
5. ***Absence of iron pick-up*** in deposits made on iron and steel, thereby avoiding hard spots and cracks.

WORN SPINDLE for a 60-ton lathe repaired by building up worn surface with Anaconda Nickel Silver-828 Welding rod by oxyacetylene braze welding. The estimated saving over the cost of a new spindle was nearly $2500.

Surfacing operations which are regularly done with Anaconda Welding Rods include the overlaying of bearing surfaces on iron and steel, and the rebuilding of worn items such as pistons, shafts, valve mechanisms, gear teeth, bearing surfaces, propeller and impeller blades.

Details concerning the type of rod and procedures recommended for surfacing various metals are available in Publication B-13, "Anaconda Welding Rods."

Free technical assistance. In most cases, Anaconda distributors can help you select the exact rod you need for your job. But if you have special problems, Anaconda welding engineers are at your service. For a copy of Publication B-13 with comprehensive information on Anaconda Welding Rods and procedures — or for technical assistance — write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

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